# "A Qualitative Exploration of Extent of Digitalization in Shipping & Logistics sector"

Research dissertation presented in partial fulfillment of the requirements
for the degree of

**MSc. International Procurement & Supply chain management**

Griffith College Dublin

**Dissertation Supervisor: Dhafer Alahamari**

**By**

**Kanwalpreet Singh**

26th August 2019

# Student Declaration

Candidate Name: **Kanwalpreet Singh**

I hereby certify that the dissertation entitled:

A Qualitative Exploration of extent of digitalization on shipping & logistics sector, submitted for the degree of MSc. In International Procurement & Supply chain management is the result of my own work and that where reference is made to the work of others, due acknowledgment is given.

Candidate Signature: *Kanwalpreet Singh*

Date: 26th August 2019

Supervisor Name: Dhafer alahamari

Supervisor Signature:

Date:

# Dedication

All the work is the blessing of my parents**.** So definitely I would dedicate this work to them first and then Gurpreet Singh my brother.

**My parents Satvinder Singh** and **Balwinder Kaur,** who loved me, believed in me and supported me. Who always inspired me and have been role models for me in achieving the path of real victory. It is because of them that I dream big and have confidence that all my dreams would become true. This report is also a dedication to my professors who are my guidelines. I am blessed to have loved ones in my life who have confidence in me and I dedicate my work to all of them.

# Acknowledgement

I would like to thank **my parents** who supported me in all my decisions and raised me and educated me the best way. It is only because of their love, support, cares and understandings that I am able to do my professional studies. They actually are my strengths and spirits. I would specially appreciate my father who trusts me with all my decisions.

Secondly, I'd like to show my gratitude and appreciation for the candidates, who took out time from their busy schedules for the interview.

And lastly I would like to thanks to my supervisor **Dhafer Alahamari** for their assistance in advice and time through their valuable experience in helping in completing my research

Kanwalpreet Singh

# Abstract


## A qualitative exploration of extent of digitalization on shipping and logistics sector

Shipping is one of the major transport of carrying goods with 90 % of world trade cargo was carried through ships. It incorporates complex flow of goods through its different elements ships, freight forwarders, logistics and ports. Shipping has been considered as somewhat conventional industry to adopt the technological advancements compare to other industries with containerization was being last disruptive change in shipping industry. This tendency is changing in the view of scope of digitalization and its applications on maritime industry. This study will help to identify the extent of digitalization on shipping and logistics industry and its concluding impact on optimizing the supply chain efficiency. Different technologies and their applications has been shown which are either being implemented or already in testing phase. In this study discussion on initiatives taken by different shipping companies and port organizations to incorporate technologies in their operations and how these initiatives are optimizing their functions and their effect on overall efficiency of their operations is also being discussed. Along with that the challenges has also been identified while implementing these applications. This study will help in understanding the future of shipping and its evolvement from a traditional structure of logistics complexities to a digital framework with all the elements interconnected with each other by information flow and shared data. This qualitative research followed a grounded theory approach in which 6 participants associated with different elements of maritime sector from seafarers to logistics consultant were interviewed. The interview carried out were semi structured where open ended questions were asked to collect data which helped in understanding the current scenarios of shipping and recognizing the initiatives that are being taken to transform the shipping and logistics industry to a digital framework.

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# 1. Introduction

Supply chain management is a complex system of flow of items from organization or manufacturer to end customers. It incorporates the dynamic streamlining of supply-side activities to augment client worth and increase in competitiveness in the market(Min, Zacharia and Smith, 2019). Proper management of supply chain network can reduces end costs, expenses and results in better efficient cycle. With increase in globalization there is persistent strain to build the productivity and improvement of supply chain network(Chandak, Chandak and Sharma, 2014). Transportation of goods are fundamental of supply chain process either by roads, railways, shipping and air routes and it often involves complex nature of processes, long paper trail, and time delays related with it.

Among all these modes of transports shipping is an integral part of supply chain and major proportion of cargo movement globally is carried out through ships. Whether it is inland shipping or international freight forwarding, shipping plays a very significant role as bulk quantity of material can be moved at a time which made it relatively cheap as well among others mode of transportation for instance trucks and railways. Shipping represents 90% of world trade and considered as a life blood of global economy(ICS, 2017). As per UNCTAD in 2016 10287 million tons of cargo was carried by shipping and around 20 million containers have moved throughout the world covering 55057 billion ton-miles of distance all around the world (United Nations Conference on Trade and Development, 2017). Other than being economical, ocean freight is much more environmental friendly then other modes of transport with an extensive coverage throughout the world and multiple carrier options available for customers (OECD, 2017).

Over the most recent few centuries universal trade has developed essentially and changed the manner in which our world trade works. Over the most recent couple of decades, exchange has expanded at a quicker rate. Toward the finish of the nineteenth century, the entirety of world imports and fares was lower than 10% of world production, yet in later periods, the worldwide parity of exchange expanded to over 50% production(Ortiz-Ospina, Beltekian and Roser, 2018).

The topic that will be focus on this research is how advancement in technological innovation and digitalization has its impact on shipping & port sector and its overall effect on whole supply chain & logistics. The title of the research is "To explore the extent of technological innovation on shipping with context to supply chain management".

## 1.1 Purpose of Study

In this research, the aim is to explore the extent to which new advancements in digitalization is impacting on supply chain process with regards to shipping. The research will be focused on new technologies that are being introduced and how it is affecting the shipping and logistics industry. Technologies like Blockchain, Shipping 4.0, and Internet of things are making way into sector gradually and present an advance future for shipping. Idea behind this research is to understand the changes these technologies will bring with them as well as challenges that can be arise due to such innovations. The conclusions of this research will help in better understanding of future scenarios of logistics part of supply chain which includes digitalization of different elements and hence enhancing the connectivity within different elements of supply chain.

## 1.2 Significance of study

Shipping industry is a broad network and it works on global level and with economies of some part of world are dependent on it due to huge import and export practices(ICS, 2019). However the extent to which different shipping companies operates or scenarios of geopolitical situations around the world diversify the extent of operating level of shipping for instance, small ships covering short sea routes and geographical areas and large companies with more number of ships in fleet working all around the globe(Marine, 2019). Big companies are working with advance infrastructure and frameworks as contrast with small company's organizations, making more value for business because of accessible assets.

With continuous changing economic trends and to meet varying market demands it become essential in current times for every sector to sync its growth with digitalization and needs to keep its pace with technologies and innovation in the way which it operates (Moon, 2017). With every day innovation is breaking through and businesses are entering into an era where more businesses affected by digital & automation based manufacturing and conventional manufacturing plant floors with physical laborers are being supplanted by automization.

These progressions have such an effect on economies that their entirety is difficult to capture(Pillsbury, 2019). With its far reaching network globally, size of economy and number of applications it incorporates shipping sector has tremendous scope to adopt technological advancement and transform their operational procedures and strategy that how organizations can create a value for their clients and at last contribute towards more effective supply chain management(Lacey and Lisachuk, 2015).

Numerous technologies like Blockchain technology, Internet of Things, autonomous vessels, container tracking, real time data monitoring, weather forecasting, smart contracts, environmental friendly engines, digitalization of ports, big data, containerization, container parameters monitoring are named to be few which are either in testing phase or already adopted and ready to transform the shipping industry to uplift itself from a rather conservative phase to a new platform of modern shipping (Egloff and Sanders, 2018). Connecting all the elements involved in a shipping process can results in creating far better efficient chain of moving material from one point to another by setting up a better communication and clarity of future needs. By efficient use of cargo spaces, avoiding blank sailing, reducing the possibility of running ship under capacity and better management of cargo can be achieved by adopting more innovative and advance technical methods. Around 86% of customers believe that there will be increase in overall efficiency by automation and can results in increase in ability of companies to meet customer demands (McKevitt, 2016).

The focus of this research will be majorly on companies that are dealing with mostly on container ships and cases of few market leaders of shipping container companies will be taken into consideration like MAERSK which are using their resources to develop new innovative platforms in collaboration with companies like IBM to create new technologies which are capable to transform the market and can change the framework in which current market operates resulting in more flexible and better efficient market(Del castillio, 2018). Along with it research will be carried out to study the extent in which these technologies can be integrated into current operational practices and how this innovation will affect whole maritime sector.

## 1.3 Aims and Objectives

The research will be carried out & focusing on following objective

***To understand and explore the extent of digitalization on shipping & logistics industry.***

***To investigate the opportunities and challenges that digitalization will be brought on whole supply chain process in context with shipping industry***

## 1.4 Research Questions

The research carried out on above mentioned objective will be able to better understand and answers the following questions

- What are the current scenario going on in maritime industry and its extent to integrate technologies in their operations by shipping companies
- What are the opportunities and challenges that digitalization will be brought on whole supply chain process in context with shipping industry.
- How to gain information on new technologies that was introduced lately and scope of its applications on elements of shipping industry.

## 1.5 Structure of dissertation

The exploration is separated into 5 sections, each area added to the research process and gave direction in accomplishing the define research objective.

### Chapter 1

In the first section, the issue underlying the research was presented briefly, research objectives were clearly presented along with the relevant questions that are intended from these research questions besides, reasons for undertaking the research on shipping sector described as well as its importance to the supply chain industry as whole.

### Chapter 2

In the second chapter the research subject is unfold by exploring the relevant research and conducting the literature review of relevant theories and previously conducted studies available referring to digitalization of shipping and logistics sector. This chapter will be concluded by conceptual framework where all the relevant theories from literature review will be interlinked to explain the connection between initiatives taken by shipping companies along with new technologies that are being underway which leads to emergence of new

markets in the form of third party companies and their concluding scope on digitalization of shipping. Along with this challenges and opportunities which arises by relevant theories and their ultimate effect on overall scope of digitalization of supply chain management will be discussed.

### Chapter 3

In the third chapter of methodology and research design, a detailed explanation is given mentioning the research approach and strategy was presented. The qualitative approach was taken to for data collection, under this approach semis structured interviews has been taken and how the findings of those interviews for data analysis was explained. Details of interviewed participants and the whole process of interview have been shared. Along with the details ethical issues associated with the interview and its implications has been addressed. Analysis of gathered data and its interpretation by using appropriate coding and analysis method was also described.

### Chapter 4

In the fourth chapter of data analysis and findings, details regarding examination of data and information gathered through data analysis described. The findings through this data were assessed critically and presented in final discussion.

### Chapter 5

Limitations, contributions and implications made to the sector undertaken by this research was highlighted in final chapter. Findings and recommendations were shared to put in practice and for future research work which can be aid in betterment of sector.

# 2. Literature review

*A literature research review is a deliberate, unequivocal, and reproducible strategy for distinguishing, assessing, and combining the existing body of finished and recorded work created by specialists, researchers, and professionals* (Fink, 2008)

## 2.1 Overview

The purpose of this literature review was to analyze the area of research to rediscover the investigations that were at that point already been conducted and to gain information and experiences that could make ready to facilitate exploration and development in the matter of

subject. In this chapter, research studies and theories related to shipping and logistics industry will be reviewed. The work mainly is done on the aspects of digitalization on shipping and logistics sector with respect to shipping.

Being an integral part of supply chain, shipping is still considered as somewhat untouched by digital revolution in the context of whole operational process(Meijer, 2017). Only few to be named shipping companies are so far indulging themselves to move forward with whole concept of digitalizing their process. All sort of new technologies have been introduced to modernize the fleet of ships but little work has been done to improve the overall process cycle. Due to complex nature and somewhat interdependency of all elements on each other leads to limited adoption of digital innovation in business practices. The literature available in the form of journals, newsletters, scientific papers, blogs, company's information websites, and previously done researches will be taken into consideration. The answers of relevant research question will be tried to resolve through literature reviewing. Lastly the chapter ends with the conceptual framework that will provide an overall outline of the important issues which needs to be addressed by interlinking them with relevant theories and it should be regarded for better understanding and exploration of the research subject.

## 2.2 Role of shipping in supply chain integration

The supply chain is a network between different elements like suppliers, industries, warehouses, distribution centers to move product from one end to another end and ultimately delivered to customer(Kenton, 2019). Supply chain management is the strategic and operational level decision making that enhances supply chain performance. The strategic part of supply chain deals with the network i.e., choice of suppliers, transportation, manufacturing facilities, distribution centers, and so forth. The strategic level plans and timetables the inventory network to fulfill real need. The operational level executes plans(Dullaert *et al.*, 2007). Decision making in strategic and operational level are distributed over the supply chain network. In order to increase efficiency whole network of supply chain is integrated with all the elements involved are interlinked to each other(Awad and Nassar, 2010).

Supply chain integration in maritime industry is associated with optimizing the performance with the coordination and collaboration of all the actors to manage intra and inter organizational processes .For instance connecting port facilities with the railways and setting

up warehouse and distribution centers near ports. In order to achieve greater efficiency and responsiveness shipping firms are integrating their operations both horizontally and vertically (Panayides, 2006). But lately this approach is declining with companies are more inclining towards setting up Joint ventures, strategic alliances and slot sharing arrangements.

Shipping industry is a network centric industry and thus requires collaboration across its supply chain. Since it is operating on global levels so individual across the shipping is dispersed geographically so information and communication technologies with digitalization and innovation have capabilities to enable collaboration among different shipping organizations and players as well(Bhardwaj, 2013).

However with the evolution of digital structure in shipping, data sharing was not facilitated very commonly thus allowing less efficient collaboration among supply chain network(Coles, 2017). Although there is huge advancement in technological innovation solely among different elements for example, advance technology onboard ships for navigation purposes and high tech machineries for propulsion, development of port infrastructure and adoption of digitalization on port operations, cargo tracking services and advancement on storage and warehouse facilities but lack of interlinking of this data from all these elements is rarely available and thus information available from all these system cannot be integrated with each other(Fruth and Teuteberg, 2017). Digitalization of maritime industry provides solution to this by integrating the information available on different channels and processes that data to provide real time information to all the actors. In addition to increase in efficiency it will lead to increase in responsiveness for instance with update voyage plans and real time information available on arrival and departure of ships resulted in coordinated transportation system with seamless operation at sea and in connection with supply chain beyond that (Feibert, Hansen and Jacobsen, 2017).

Further application of digitalization includes are to integrate different modes of transport ships, rail, road to develop an intermodal transport system. Pacific international lines, PSA international, and IBM Singapore collaborated with each other to experiment on blockchain based supply chain network.

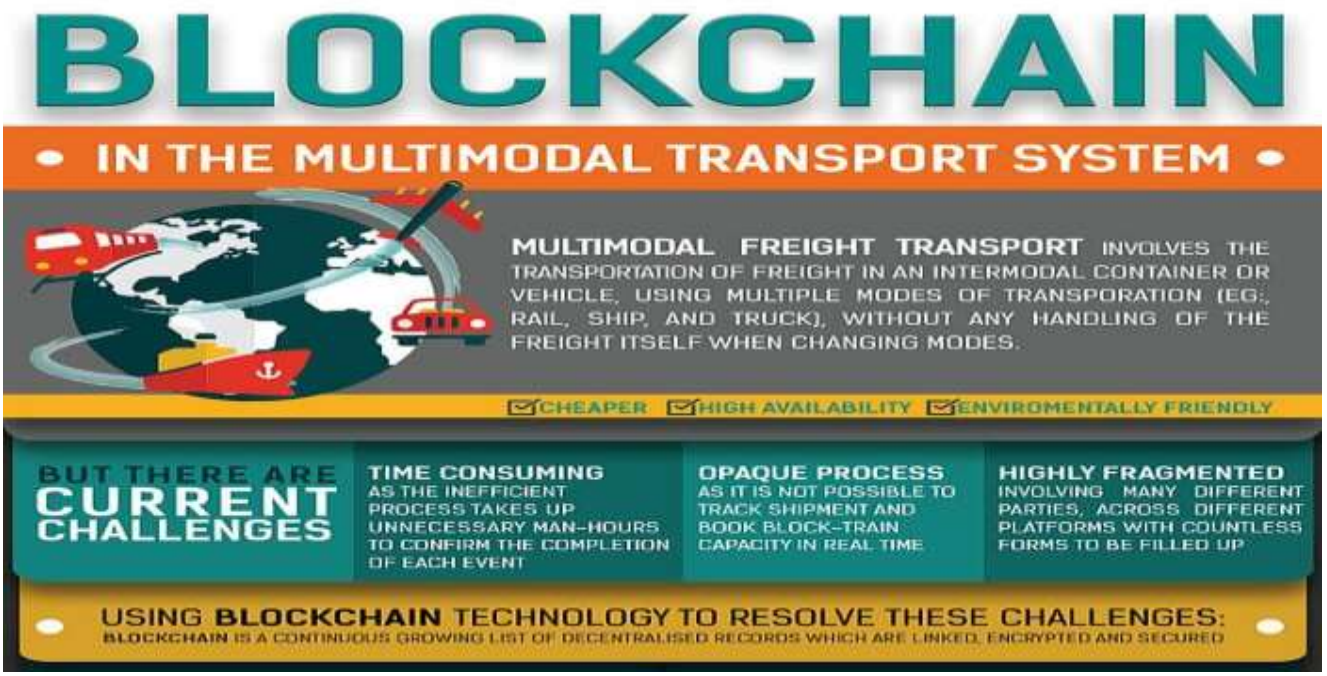


Figure 1 Blockchain Multimodal transport system (International, 2018)

Idea behind this intermodal transportation system is to develop the integrated transportation system with to increase efficiency and time responsiveness with great visibility in supply chain.

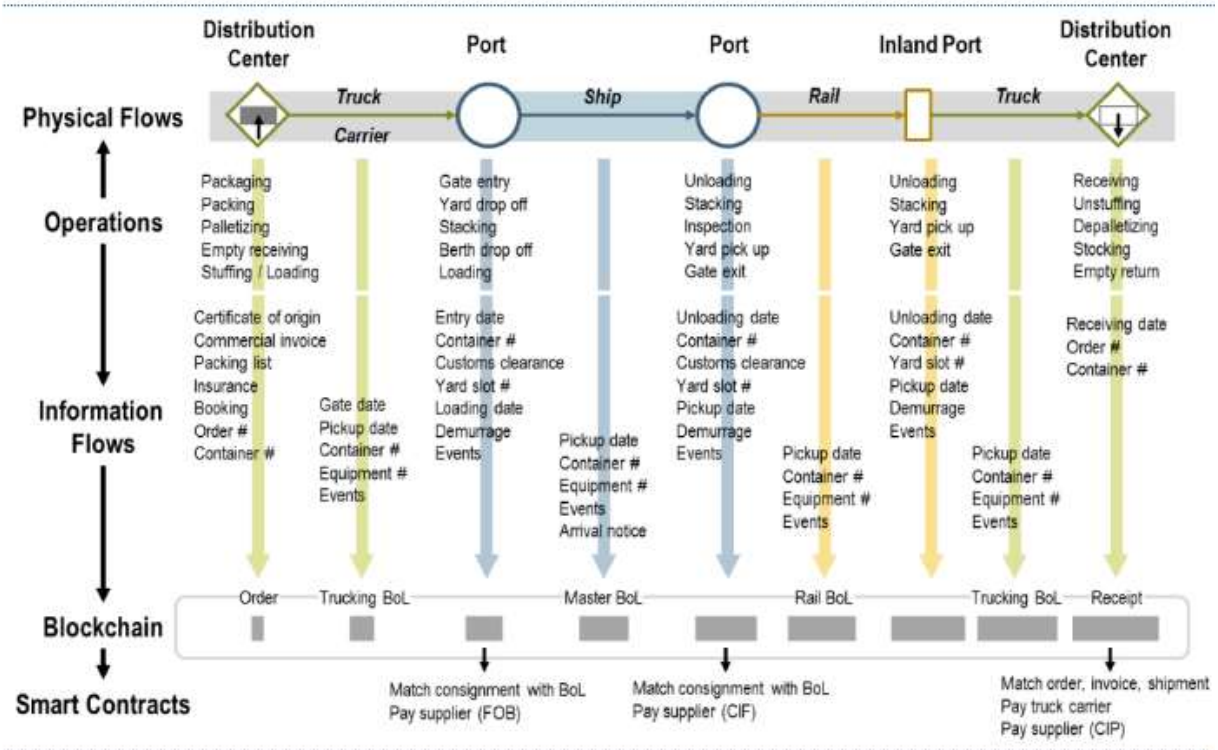


Figure 2 Digital intermodal of dry cargo (TransportGeography, 2018)

In the above figure, an intermodal chain shows an exporter, importer along with different modes of transportation and terminal in between. Although block chain technology does not affect the nature of operation drastically but it considerably changes the manner in which data is stored and shared among all the parties.

For instance, at the origin of cargo, order generates information like certificate of origin an invoice, a packing list and booking of transportation to move the order to a specified destination. This information will be stored in a blockchain and made available to other carriers and all the players along the supply chain. One of the applications will be generation of bill of lading. This bill of lading will be further be used by intermediary transport like trucks and comes into action once the cargo picked up. This information will be including details of transportation services such as truck and chassis number, and all the notable events during transportation like passing toll, duration of stops etc. (TransportGeography, 2018). Once the cargo reaches the container terminal smart contract will be generated with real time information and further whole process can be monitored by all the players. This application of technology will integrate the complete transport, intermodal and transactions carried through this intermodal chain(TransportGeography, 2018).

## 2.3 What is digitalization

To explore the scope of digitalization in supply chain management, the understanding of term digitalization is essential. There is a misconception in context of understanding of these terms digitization, digitalization and digital transformation. Although these terms points towards same directions of objectives but their understanding of definitions and their implications are different and application of these terms varies from industry wide(Bouza, 2019). Digitalization refers to tendency of any company for the application of digital technology in their business practices. Digitalization refers to when organizations begins adopting digital practices to change their business models and restructuring of domains using innovations in communications.(Bloomberg, 2018).

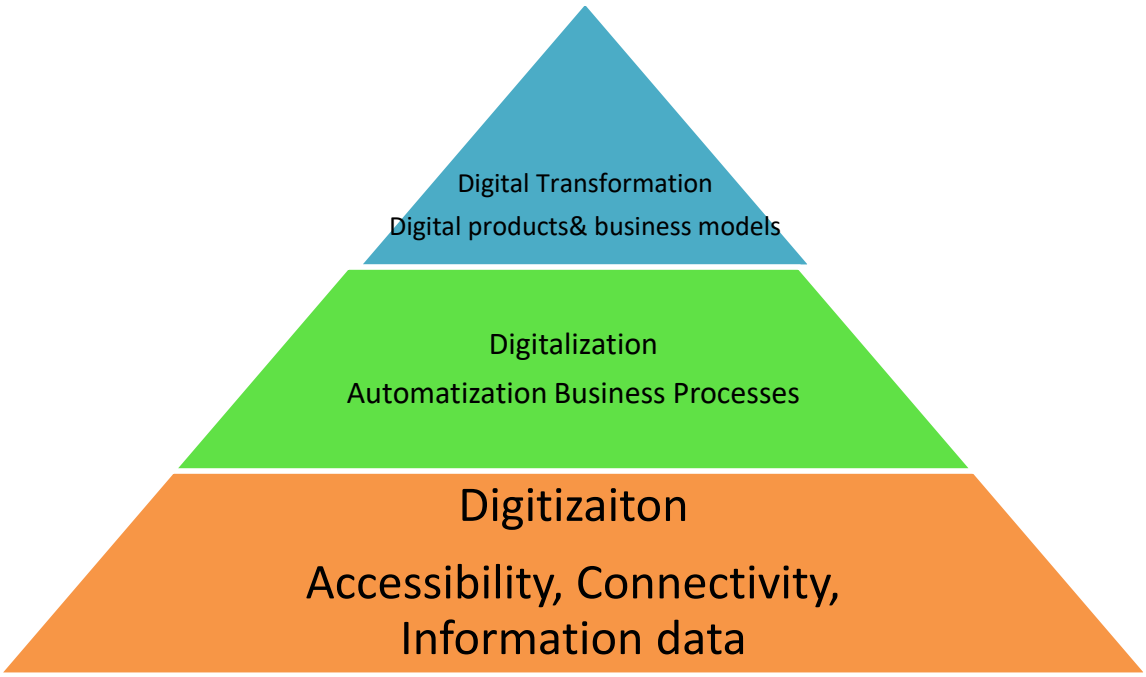


Figure 3 Digitization, Digitalization, Digital Transformation

There are many factors that can be associated with adoption of digitalization in any industry, for instance poor performance and less growth by existing traditional structure. Digitalization is as of now affecting business conditions and the corporate method for conducting operations. Neglecting the scope of digitalization could make a danger of losing the game in the profoundly competitive markets (Henriette, Feki and Boughzala, 2015). Digitalization can affect an organization's whole operational conditions and internal functioning. Digitalization can likewise bring new business openings, change the jobs of administrators in a value chain and end existing business structure(Accenture, 2016). For instance, digitalization may remove conventional intermediates in the supply chain network and make new intermediates. This can be expected to, for instance, direct access to buyers and the expanded utilization of communications systems.

According to Tihinen 2017, From three different perspectives the scope of digitalization can be identified for any business and organization(Tihinen and Teppola, 2017). These three different perspectives are as follows:

**Internal changes**: These can be referred as changes in business practices to increase the overall efficiency of any firm. These changes can be received in any organization by an

efficient working environment via digital means or by reorganizing the whole internal business structure(Kenton, 2019). The potential advantages of digitalization for internal efficiency incorporate improved business process proficiency, quality, and consistency through disposing of manual handling and increasing better precision. Digitalization can likewise enable a far better real time watch on operations and results, by coordinating organized and unstructured information, giving better perspectives on company information, and coordinating information from different sources(Gupta, 2018). Besides, digitalization can promote better work fulfillment for employees through incorporating automation in monotonous routine work, which can also lead to make space for development of new skill among employees. Digitalization likewise improves consistence by means of standardization of records and improves recuperation by means of simpler backups and dispersion of capacity.

**External Opportunities**: It is referred to as new opportunities that will arise in businesses by reshaping the whole business domain in the form of new services, new customers and new associations. Incorporate improved reaction time and customer administration, just as potential outcomes for better approaches for doing business. New computerized innovations can make open doors for new administrations or propelled contributions to clients(KInthaert, 2017).

**Disruptive changes**: Digitalization can cause reshaping the entire framework in which an organization operates and as a result it can cause changes in business role and the objective of business functionary role. This can lead to change in current business environment or complete overhauling in which it becomes obsolete due to changed situations. For instance, replacing the conventional documents like bill of lading and invoices to more smart contracts and electronic invoices.

According to Maarit 2017, the present patterns of digitalization change the basic fundamental on which organizations work. The progressions can be new potential outcomes to get things done all the more effectively or affordably, yet they can likewise be hindrance to an organization's present activities, as digitalization on a very basic level changed an organization's business opportunities(Parviainen and Tihinen, 2017). Digitalization does not necessarily mean transforming existing procedures into digital versions, however

reconsidering current tasks from new viewpoints empowered by digital innovation(Tihinen and Teppola, 2017).

According to UNCTAD 2018, there is much needed growth in demand of sea trade and there is huge scope of adaption of new technologies which can increase efficiencies in term of cost effectiveness, environment and time. Many technologies which are already incorporated and being in adoption phase are providing an opportunity for shipping and port stakeholders to bring additional value in terms of greater safety, more productivity and environmental protection. For instance, numerous blockchain technologies initiatives and collaboration with companies can provide updated information for tracking of cargo results in much greater end to end visibility in supply chain.

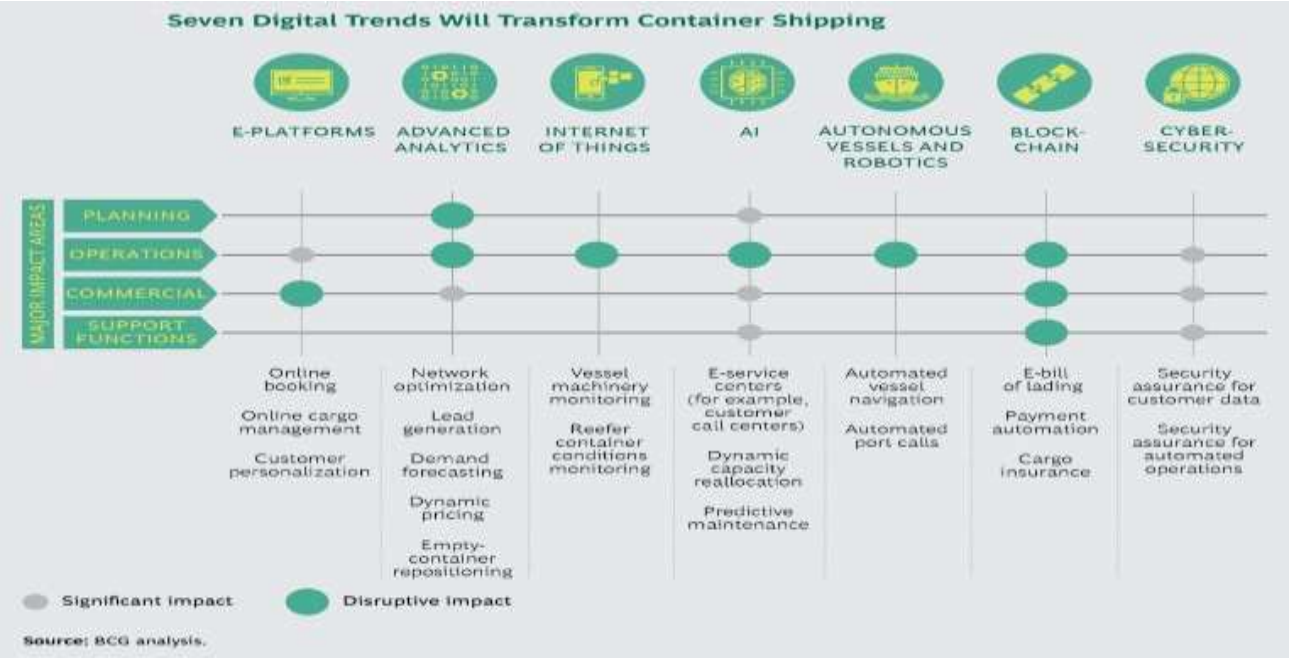


Figure 4 Digital imperative in container shipping (Egloff and Sanders, 2018)

By connecting data available onboard vessels and digital systems vessels and their cargo can be integrated to become a part of internet of things(UNCTAD, 2018).

## 2.4 Technologies transforming shipping sector

Innovation opens the new opportunities for ship owners to make strong their connection with customers, moreover it should lead to decrease in expenses in terms of fuel costs, vessel activity and customer association and search for after new pay streams past traditional

transportation (Levins, 2018). Simply couple of shipping companies has associated trend setting advancements toward updating their business and operational activities. Container repositioning system, voyage planning, cargo tracking system, assessing and documentation are among the exercises that these shipping companies have begun to digitalize(Shin, 2018).

Inspite, of the way in which the end results of advanced change can be immense and progressive however so are the difficulties to causing it to go. To succeed, shippers must get a sorted way to manage portraying a propelled vision and combining new advancements, limits, and disposition into their standard system for working(Seman, 2005). Organizations that approach an advanced change with the right directions, resources, and scale can bounce to the cutting edge of advancement.

Hereby insights are given about concerning innovative spaces which can be interlinked with shipping and reform the market in terms of digitalization. Research is reaching out to three distinct areas of shipping that is ship design and shipbuilding, cargo delivery and port infrastructure.

- **Internet Of things**: All the machineries installed are outfitted with sensors and transmitters, these sensors are fundamental to keep up and screen the parameters for safe task of ship and cargo(Jang *et al.*, 2002). Container location tracking and reefer container temperature observing are not many of the applications that can be executed by interlinking with the help of Internet of things.
- **Blockchain Technology**: Shipping includes a long paper trail including deal contracts, bills of lading, contract between parties, port records, letters of acknowledge and others related for the vessel and the payload. Every single record needs to experience a long preparing time as it holds a critical incentive for both client and transporter. This includes enormous time taking procedure and blockchain innovation headway will change supply network framework and freight exchange over ocean courses. This will make from an immature industry process towards a standard method for executing in maritime and by and large supply chains(Wingrove, 2018).

- **Autonomous vehicles and robotics** : Autonomous vehicles are not simply prepared to set transformation in ports where they are now in application for example like port of Antwerp, Rotterdam port however it will likewise have critical effect on maritime vessels. World first self-running vessel Yara Birkland run by Norwegian companies Yara and Kongesberg effectively set to begin sailing in Norway 2019 and could transform to completely mechanization in 2020(Kongsberg, 2017).
- **Artificial Intelligence**: Artificial intelligence is spreading its footprints in each industry and shipping is likewise not isolated from it, uses of innovation alongside mix with huge information improves it usage of accessible data to have better command over procedures. In April 2018, OOCL a Hong Kong based shipping company partnered with Microsoft AI research Centre MSRA to use their capabilities to optimize their network operations and resulted in $10 million USD/annum(Thetius, 2018).
- **Big data**: Big data is prepared to bring revolution in terms of digitization, as there are numerous machineries and equipment present onboard recording data and parameters available. Big data is useful in assessing, storing and analyzing that information(Tas, 2018).
- **Virtual reality Augmented and mixed reality**: These are the instruments that can be integrated to use as advanced imaging of ship voyage and to decide the factors like birthing, navigation and channel travel.
- **The cloud and edge computing**: It makes all the innovation accessible to interconnect with one another and act as a coordinated framework making it monetarily feasible.
- **Digital security**: Cyber security is one space which should be underlined substantially more than other to guarantee digital security and abstain from rupturing of any confidential data.
- **3D printing and additive engineering**: Ship engines and machineries are vulnerable part and require planned maintenance system and overhauling from time to time. Unavailability of spare parts is one issue which can defer the ship stay time at ports and cause unnecessary postponements. 3D printing and additive engineering are few of the systems which are in planning phase to incorporate the arrangement of minor

spare parts and to save time and costs and thus increase in overall efficiency(Temple, 2018).

Digitalization is an old subject with impressive measure of research is been done regarding various ventures. In any case, it isn't been done in the majority of the advancements in individual area and along these lines undermining the maximum capacity of innovation(Nkuna, 2017). For example Robotics and its applications are being studied and researched on wide scale but other technologies, for example, AI, Big data, Cloud, security are named to be few which are still under researched for their applications in improving efficiencies in maritime sector.

Further geographical regions which are more indulge in research and studies in regards to maritime innovation for example, China, Korea, German, Norway are not many among the nations that are leaders into changing the digitalization of sea transport(Medmaritimeprojects). Unintentionally these nations are showcase pioneer of ship building and ship producing segment. Additionally more research is being done in growing increasingly refined and interlinked ports as they have great network with inland vehicle.

Although shipping and logistics is one the major stakeholders of a supply chain but it is characterized by high cost of operation and high pollution levels associated with it. As a result of this it is one of the most affected industries with stricter laws and regulation imposed by International Maritime Organization. Along with the challenges due to compliance with laws maritime industry is continuously in pressure by other conventional factors such as shipping cycles and geopolitical situations which impact the world trade and hence fluctuations in market(Lee, Kwon and Ruan, 2019).

However in consideration of all these factors, there is a great opportunity underlying for looking for more diverse solutions and applications of innovative technologies. Although digitalization is an old topic with a considerable amount of research already been carried out but its industry specific application is still not completed. Among all those technologies mentioned above many of the technologies are already incorporated in maritime industry and its support services in form of prototypes or experiments.

Scope of digitalization in maritime logistics is mainly focused on data and information management systems. Typically inflow of data in supply chain is 100 gigabyte per day and it is expected to increase up to 35 zetabytes per day(Tien, 2015). Shipping companies are apply data driven technologies in their procedure for some time now for instance MAERSK which introduced its first blockchain application platform in collaboration with IBM named as TradeLens. This platform act as blockchain ledger for better secure sourcing of shipping data resulting in efficient global trade. Since its initiative in January 2018 so far TradeLens accommodated more than 100 organizations which includes 4 ocean carriers companies, three inland carriers and 40 worldwide ports and terminals and 8 customs authorities extending its reach from Rotterdam to Bahrain(Tradelens, 2019). Recently 2 shipping giants in container sector CMA CGM and MSC have joined Tradelens which results in approximate half of world shipping data is being processed through this venture(Scott, 2018). Main idea behind this initiative is to increase the overall efficiency of whole shipping process by reduction of costs through increase in visibility in supply chain and eliminate the inefficiencies through paper based process.

Trade lens use blockchain technology to integrate trade data from all the partners and then process it to provide real time and secured information to end to end supply chain to all the actors involved of any events and news including shipment condition and container condition like location, details of shipment, owner of cargo, temperature of shipment in case of reefer cargo and time it will reach the end destination. This data can not only increase visibility throughout the supply chain but also can be used as documentation in end functions by enabling end users to submit, stamped and get approval of documents through secure means(IBM & MAERSK, 2018).

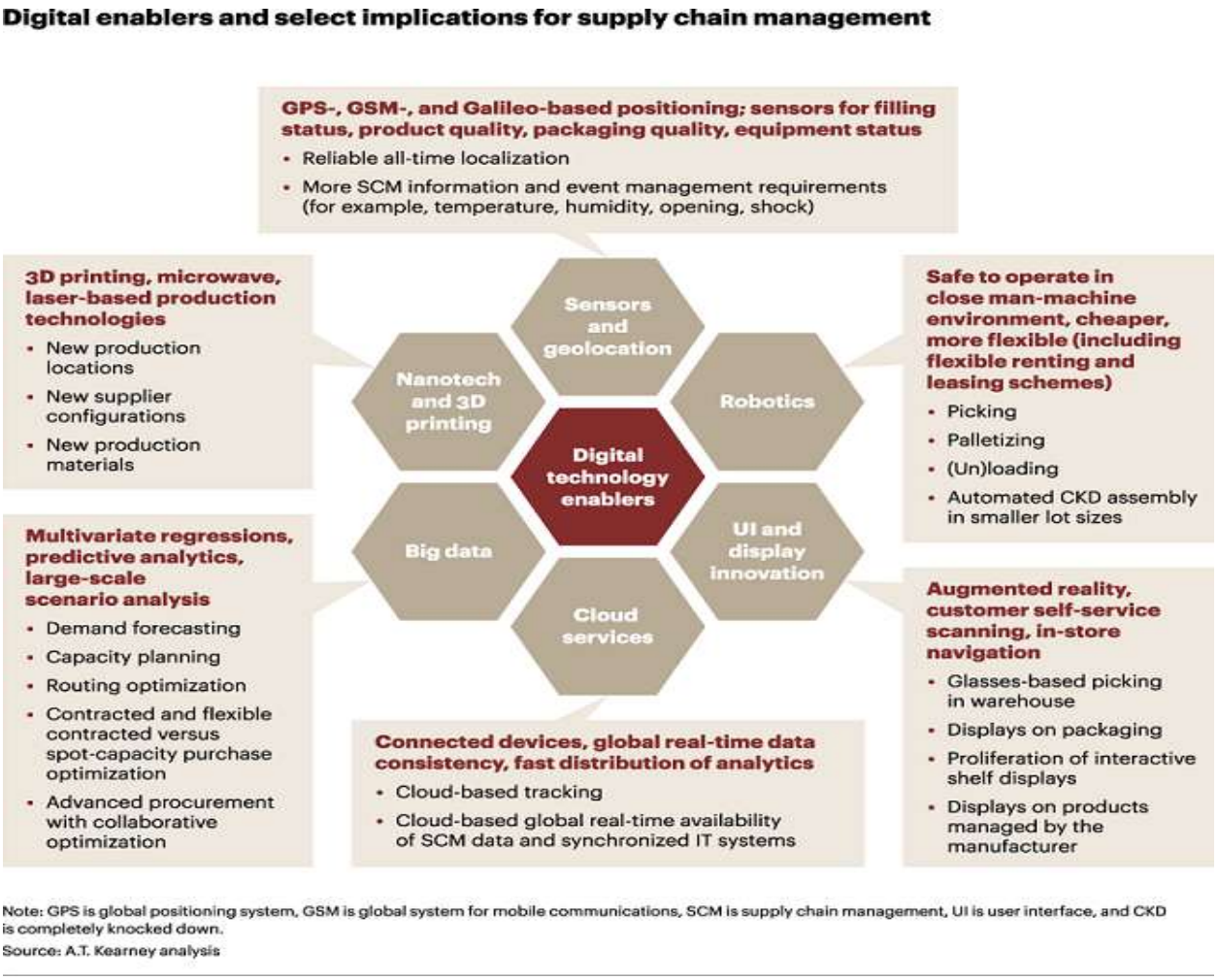


Figure 5 Digital technology enablers(ATKearney, 2015)

A.T. Kearney's European Excellence in Supply Chain Management also revolves around digitalization. Coordinated commonly with the Kühne Institute for Logistics Management at the German business school WHU–Otto Beisheim School of Management, it jumps into the habits in which that digitalization in most of its courses of action effects store network the executives , in perspective on contribution from 60 mechanical and business associations all through Europe. The investigations incorporates the new innovations that are going to influence the production network the board in close-by future(ATKearney, 2015).

## 2.5 Restraints and challenges of digitalization

Maritime sector is a prime example of a conventional industry that has started slow and developed gradually over the decades to reach its current stage. Containerization was the last disruptive change that occurred in maritime which brought revolution in the way in which

shipping operates(Saxon and Stone, 2017). Being encircled by numerous regulator bodies on global as well as an individual nations it is not easy to implement any change in maritime industry on large scale very promptly. Apart from the legal challenges, problems associated with digital infrastructure are also some of the important aspects which needs to be focused upon before true potential of digitalization and innovation can be exploited(Baldauf *et al.*, 2018). These challenges can be varied geographically and on individual level on which any company operates. But the major challenges that are going to affect the transformation are

**Regulatory issues:** Shipping in numerous viewpoints is an exceptionally controlled global market. With new, challenging models of businesses and with new advancements and ideas to address specific tasks, regulatory issues frequently turned out to be significant. Typical issues and concerns include (I) regardless of whether an introduction of specific technology or any new business model and plan of action will be permissible, (ii) what changes to plans of action or advances might be required to agree to existing guidelines, and (iii) where changes in law might be expected in near future(UNCTAD, 2018).

**Information Use and Data Ownership:** Data have turned out to be progressively significant for the arrangement of services, for example in the event of planned maintenance system, data usage tracking, Voyage planning,, asset arranging and other extra services. Likewise, the different partners frequently have interests in not uncovering explicit information to other players in the area (for example service providers or spare part providers). Simultaneously ownership of data is frequently unclear. In this way, for data overwhelming services and plans of action, and for information for which the organization is keen to keep utmost confidentiality, a careful lawful assessment of the information streams is regularly a key perspective(Rødseth, Perera and Mo, 2016).

**Cyber Security:** Safety and Security have been an enormous issue in the shipping industry for a considerable length of time. With increasingly more IT oriented procedures being included and vessels, containers, cargo and so on getting connected, new zones of security are included. Security, specifically, gets another layer of "digital security", intending to shield unapproved outsiders from getting access through existing interfaces and system availability to applicable sensors and controllers. The application of existing regulations regarding safety

at sea and security guidelines and changes in such laws is often a considerable challenge(ShipTechnology, 2018).

**Obligation:** With giving over an ever increasing number of undertakings to automation, a proper assignment of dangers and risk between the different parties involved turns out to be progressively significant.

According to Nkuna 2017 Besides these conventional challenges associated with innovation and automation, there are numerous other issues which needs to be taken into consideration, keeping in mind the level on which shipping operates globally For instance:

•**International laws:** maritime industry operates within the compliance of heavily regulated framework of regulations and conventions incorporated by different organizations globally like IMO. These regulations associated with safety of people, environment and cargo onboard for instance MARPOL, SOLAS, and COLREG. This compliance may affect the admissibility of explicit advancements, for instance incorporation of automated vessels, remote control ships, Drones etc (Raimond, 2015).

•**International trade:** Shipping operated on global level and any change within the industry either by innovation or change in regulation has to be taken into account while considering numerous factors such as custom arrangements, taxation policies and regulations for appropriate fitness within the industry (Nkuna, 2017).

### 2.6 Evolution of ports and impact of digitalization

Shipping ports is defined as maritime facility where ships birth to load and unload the cargo and passengers. Conventional ports used to be located around outskirts sea coasts but many sea ports today are situated many miles inland connected with sea canals for better connectivity and time savings. In early stages ports used to be act as simple harbors with limited functions whereas modern ports developed to become a multimodal distribution hub with interlinking connections with other modes of transport using seaways, river canals, roadways and seldom air routes. Today ports are not only associated solely providing docking services to ships as loading and unloading facility but eventually it evaluated to become a part of regional distribution centers. Different elements of supply chain such as

warehouses, stores, processing facilities, distribution centers finding it advantageous to located in vicinity of ports (Woo, Pettit and K C Beresford, 2011).

Evolution in shipping is directly connected with development of ports and their infrastructure. In the early days most of the loading and unloading of cargo tend to be done by manual labor and very time intensive process. Generally it used to take a medium sized ship from 3 to 5 weeks for loading or unloading of cargo however with the containerization, operational standards developed across the industry which leads to introduction of advance gantry cranes which increased the overall efficiency of shipping by incrementing the operational speed. Along with advanced cranes overall developments of port infrastructure with more jetty's and deep docks to accommodate high capacity multiple ships simultaneously resulted in significant increase in cargo handling capacity of ports(Klomperee, 2000).

Development of smart ports concepts increases the efficiency of container handling process and made loading and unloading process very fast and efficient(Gandhi, 2019). This leads to substantial save of time but also increases the overall capacity of container handling. Smart ports are being developed or renovated, to optimize the usage of area and space to save natural resources and take maximum benefits of new technologies. For example Port of Antwerp which is using the advantages of innovations like Internet of things by sharing data and information to associate every one of the correspondences and each component of port together (DP world, 2017)). In like manner completely automated container terminal at Long beach California which control all their processes at central control management center and supplanting their machineries electricity power driven as opposed to diesel driven which makes zero emission and make them more environmental friendly. This central control management leads to efficient time saving and can eliminate out several truck trips which make overall supply chain network more sustainable and efficient.

Stakeholder in port infrastructure works with data driven strategies. Conventional maritime industry is associated with port authorities, ship crew and terminal crew but today due to complexity of shipping it involved with much variety of players exchanging real time information, including cargo and logistics, warehouse operators, freight forwarders and automation service providers for pipelines cranes and berths. This leads to adoption of

smarter solutions to increase productivity, for instance CMA CGM adopted Traxens technology which enables their container ships to communicate information about their real time locations making them connected objects and enabling multimodal transportation partners to brace themselves for arrival of container in port(Leonard, 2019).

Port of Hamburg, Germany adopted a smart port initiative which provides technological assistance to involves stakeholders by improving logistics operations, adding railway terminals with the help of sensors, using shore supplies from renewable source of energy.

Port of Rotterdam is one of the largest port in Europe with around 461 million tons of cargo and 140000 ships coming and going annually. Port authorities are aiming to completely digitalize their operations to become a digital port in coming years in collaboration with IBM(Henderson, 2018). Incorporation of technologies like Internet of things, blockchain and big data to connect all the sensors for collection of data regarding tidal streams, currents, visibility and windforce. This can enable them to reduce waiting time for ships by estimating the best time by measuring water level and tides to moor and cast the ship(Port of Rotterdam, 2018). By 2025, port authorities are aiming to receive autonomous vessels as well as setting up 3D printing services to provide spare parts on immediate demand. It is begin estimated that these initiatives will approximate save berthing time which can leads to cost saving up to $80000/hour for ship owners(Patrick, 2018).

Ports today should always improve quality, increment profitability and lower costs for shipping organizations so as to compete on the worldwide stage. Different cities like Singapore, Shanghai, Hong Kong and Taiwan have taken similar port initiatives, bringing about quicker turnaround times for the ships and progressively proficient port maintenance.

The making of keen arrangements and more intelligent administrations has helped ports push ahead. It has additionally created coordinated efforts and data sharing between the port expert and its accomplices. Copenhagen Malmö Port (CMP), a port administrator connecting Denmark and Sweden contributed intensely for the future and will open another holder terminal in 2021 concentrating on growing new, smart business arrangements(CMP, 2015).

A data sharing system would help ports gather, join and investigate the numerous sources of relevant data before cargo arrives- - via land or ocean. One of their enormous difficulties is

to bring together and deal with all the data delivered by the numerous sea industry players. These activities will progressively depend on information sharing stages and API-driven answers for connection information from various sources, including shipping and logistics companies; climate, transport review, scaffolds and railroad sensors; and the ports themselves. APIs will enable them to fabricate applications that outfit the advantages of this ongoing information. Be that as it may, these mind boggling advancements don't need to be worked in-house, enabling ports to represent considerable authority in what they excel at. An information item arrangement gives the mechanical framework to host and share various sources of information, while enabling ports to redo the information administrations they give over that establishment(Olesen *et al.*, 2014).

### 2.7 Shipping 4.0

Digitalization, digitization and digital transformation brought significant transformation regarding the manufacturing of products, this transition of process is so compelling that it is being recognized as Industry 4.0 (Marr, 2018).It represents the fourth revolution in industry which was started in the third revolution with the adoption of computers and automation and enhanced by smart systems of data and machine learning. When computers introduced in Industry 3.0 it revolutionize the entire industry and brought disruptive changes, industry 4.0 unfolds the communication and connection between these computers ultimately resulting in decision making process without human involvement.

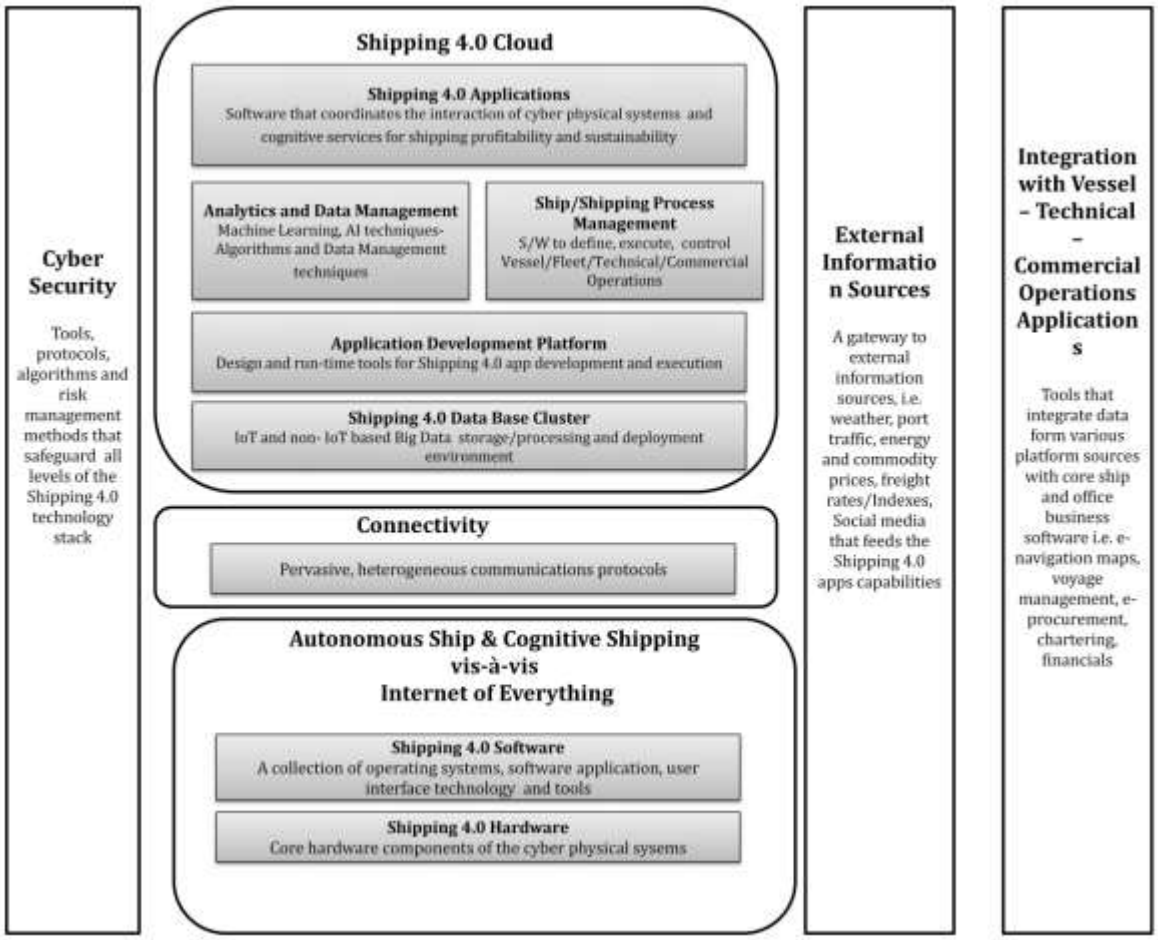


Figure 6 Shipping stack modal basis on Potter and Heppelman (Lambrou, 2017)

Shipping 4.0 refers the trend towards Internet of Things, artificial intelligence, increasing automation and connectivity. Shipping 4.0 as characterized by Porter and Heppelman is an innovation based idea which portrays how smart, connected terms generously changes capacity of any manufacturing industry.. The core focus is on- digital transformation on processing, IT, transportation, coordination and services, and after delivery management are being reclassified and the power of connectivity among them is extending. Development of new limitations, incorporating those to manage the critical measures of data now accessible(Porter and Heppelmann, 2014). Applying the Porter and Heppelman 2014 model to characterize that how innovation can cut over all layers, programming fragments to administer shipping digital security perspectives, similarly as the blend with business structures, e.g., for vessel or entire fleet checking information, dealing with the voyage and combination with outside information sources (Lambrou, 2017).

The implementation of a Shipping 4.0 is based on the framework of multilayered architecture which incorporates the configuration of hardware and software components of Internt of Things, cloud computing and digital security. So based on Porter and Heppelmann technology stack, it is composed of three core layers

**Smart ship and components layer:** In this layer, sensors, actuators and processors installed in ship key hardware systems- main engines, auxiliary engines, propellers, deck machineries, radar systems and so forth and then software components will connect all the data from these machineries to create a cyber-physical infrastructure. This becomes very much reality in newly manufactured ships which are heavily equipped with sensors showing real time parameters and minute details of every event. These parameters are being used to optimize the efficiency of ship(Sun, Zhang and Yu, 2006).

**Digital connectivity layer:** this layers setup communication protocols which enables the interconnection between individual objects of cyber physical infrastructure to cloud.

**Shipping 4.0 cloud intelligence layer:** This layers enables communication and management of connected shipping 4.0 system components while an application platform enables the development of business oriented software. The data and analytics software used in this layer is employed to store process and analyze the data generated by things(Kvamstad-Lervold, 2017).

Digital shipping comprises a moderately ongoing innovation based development result; the use of Industry 4.0 innovation and structure standards, in particular Shipping 4.0, in specific, requires novel ways to deal with the advanced change of shipping companies' frameworks, workforce abilities and corporate culture, tasks the executives, likewise decision making and strategy making rehearses (Littlefield, 2015).

## 2.8 Conceptual Framework

A conceptual framework is the mix of both the hypothesis and how hypothesis is utilized to shape the research design and the normal results of an investigation (Adom, Hussein and Joe, 2018).The conceptual framework is a key piece of the research design that spotlights on the

ideas, speculation, suppositions, discernments and hypotheses identified with your investigation (Miles *et al.*, 1994). It interfaces the reviewed literature with the research questions and helps in deciding the discoveries during data analysis. It is characterized as a visual or composed archive by Miles and Huberman that, "clarifies, either graphically or in story structure, the fundamental things to be considered—the key components, ideas, or factors—and the assumed connections among them(Miles *et al.*, 1994).

Based on the literature reviewed so far and in consideration of research aims and objectives that how the innovation is going to affect the shipping and logistics sector and its overall impact on entire supply chain. Research will be done on to explore the new technologies that are being implemented lately and are being experimented to be put in application in future. Research questions are based on how these technologies and innovation are changing the framework in which maritime industry operates. Along with the challenges and restraints will be researched to explore that to what extent these innovations will be adopted by all the players in value chain to optimize the efficiency of whole supply chain. Opportunities arise with innovation of these technologies in context of opening up of new markets and service providers will also be part of this research and how the shipping industry which is more of conventional in nature so far will adapt these changes to transform their processes to become a more connected and transparent part of a value chain.

Supply chain is flow of commodities through different players, manufacturers, processors, industry, distributors to end customer. Conventionally all these players are interlinked and interdependent on each other with very less visibility and communication in whole value chain process(Min, Zacharia and Smith, 2019). Digitalization and its application tends to set up a connection of communication among these players to make it more efficient and increase the time responsiveness. Shipping is an integral part of value chain and to understand the impact of digitalization, it can be divided into two perspectives of industry oriented approach i.e response of shipping industry to adopt digitalization in their processes and secondly on the service oriented approach that what are the challenges and opportunities that will come along with innovation and digitalization. Conceptual framework will be setup by identifying the relationship between these concepts and data analysis of findings of research.

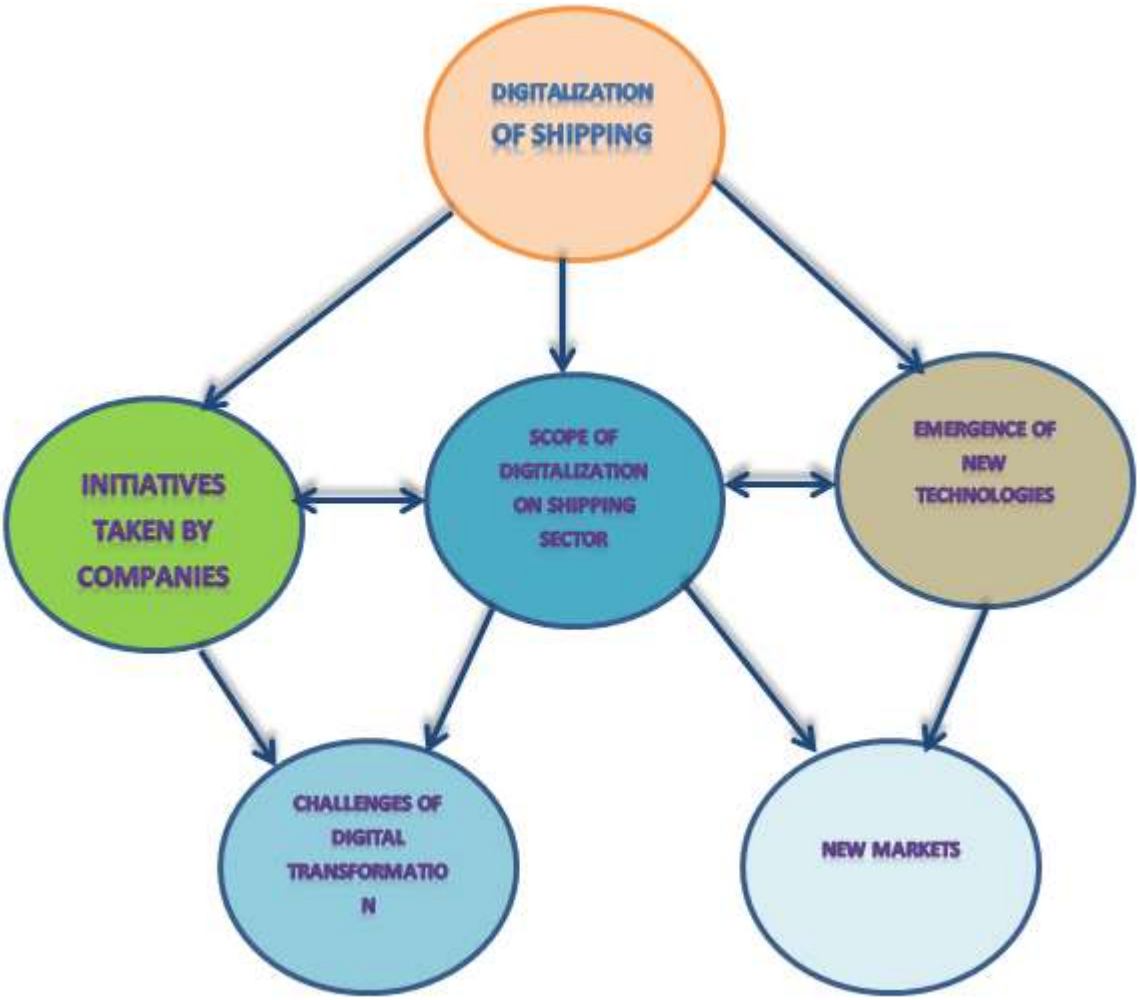


Figure 7 Conceptual Framework

Concept of digitalization -and digital transformation is not limited to any industry specific and research objective is to explore the extent of digitalization on maritime logistics. By understanding the concept of digitalization and its applications, the scope of innovative technologies on shipping, new technologies that are emerging and being developed for maritime sector and the initiatives taken by shipping companies for adoption of such innovations will be researched. All these factors are interlinked to each other as scope of innovation such as Blockchain, IoT, Big data, cloud computing influence the adaption strategy of these technologies by shipping organizations to optimize their operations. This will lead to identifying and finding solutions for challenges that will come along with these technologies and development of new market service providers with collaboration of which new application platforms will be created. For instance collaboration between IBM and

MAERSK to create a digital platform TradeLens which store, analyze and process the information to provide real time data to all the relative players in value chain (IBM & MAERSK, 2018).

# 3. Research Methodology & Methods

## 3.1 Overview

In this chapter, the methodological approach taken to conduct the research will be described and justification for the same will be explained. This section comprises of research strategy, research approach and philosophy behind that approach and the methods which are undertaken to collect primary and secondary data will be explained. The methods to collect data will ultimately contributed to analysis of data, findings of their result and finally the recommendations for whole approach. Nature of data along with the technical specifications of of used material, specifications, quantities and sources will be included. Moreover, challenges related to gain access and consideration of ethical issues in the data collection will be shared. In conclusion data analysis approach and interpretation of data will be discussed.

## 3.2 Research Paradigm & Overall approach

Research paradigm is a way of describing the worldview as perspective and set of shared beliefs which inspires the meaning and interpretation of research data(Abdul Rehman and Alharthi, 2016). Saunders et al 2009 had given Research onion framework which gives guidelines to develop and analyze to develop the research approach and design of research. This chapter explains about the philosophical approach which gives the guidance to overall research. Each layer of research onion explain about the domain in which research strategy will assist in explaining the answers of each research questions(Saunders, Lewis and Thornbill, 2000). Research onion shown below shows research design of this study and and how the conduct of this research will be progressed in each phase.

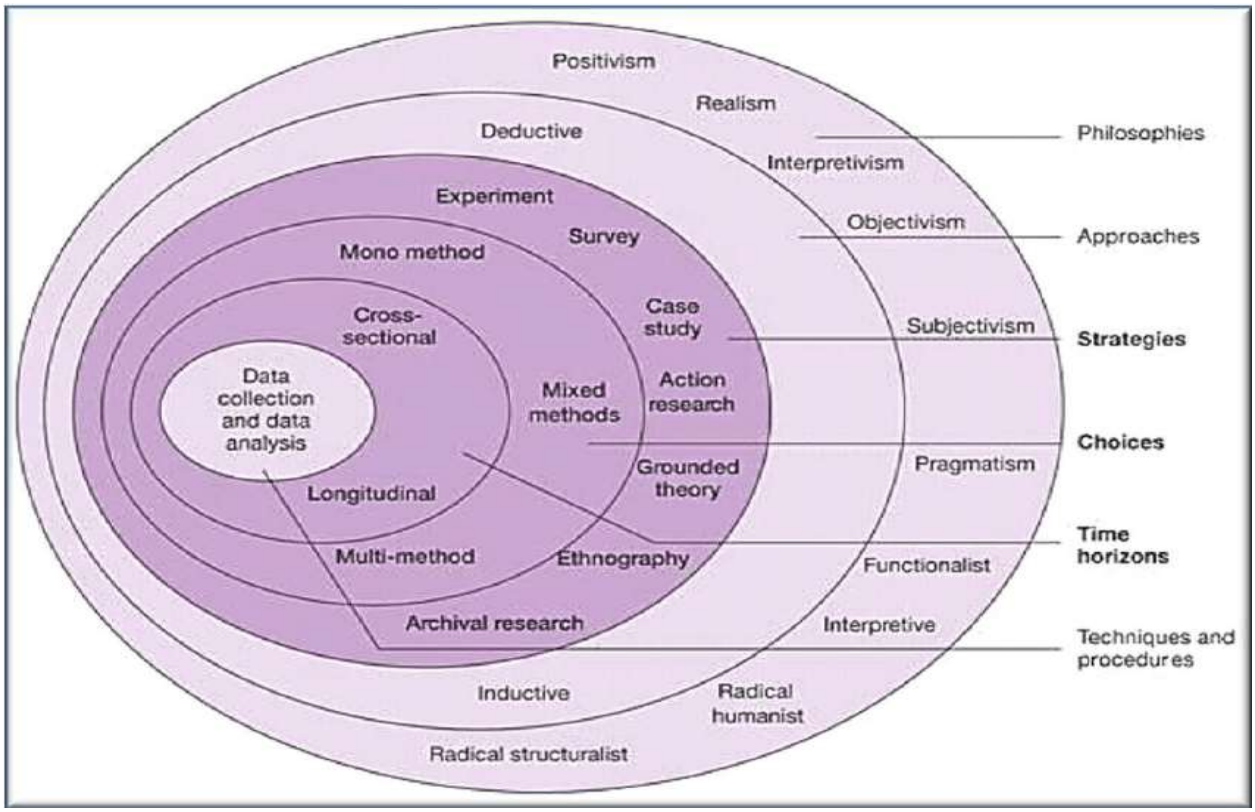


Figure 8 Research onion Saunders et al 2009 (Saunders, Lewis and Thornhill, 2009)

Since its commencement hundreds of years ago, shipping has experienced different phases of evolution, with people using shipping to explore new lands and traditions to transportation of goods and methods for trade until 1956. At the point when standardization of shipping occurred and container ships revolutionize the methods for trade(Goksu, 2017). Shipping is a diverse sector and methods of doing operations vary on the basis of many factors such as type of cargo, geographical area in which shipping company operates, the research was conducted to accumulate information from experts in different arena working on different professional levels including seafarers working on ships, professionals working on technologies like blockchain, experts and researchers which are assessing the future of these technologies and their Impact on shipping and logistics sector in order to cover all the levels and to accomplish an all round perspective on the research questions and to determine the inclination that every expert can provide to analyze the research subject on behalf their experience, position and interest. To gain a better understanding of research subject by analyzing the thick and thorough abstraction, a **Qualitative approach** of research was found

suitable. Qualitative research is limited on its own dependent on the context it is carried out with so to carry out this sort of exploratory research is good with an inductive procedure.

Today digitalization and innovative advancements has its effect on each industry, to contemplate the degree of digitalization on shipping leads to choice of **Interpretive** kind of philosophy as the principle approach behind this research. As per Saunders et al. 2009 interpretive researchers translate the component of research and consequently it coordinates the human enthusiasm into the investigation. This way of thinking stressed more upon the qualitative research approach over quantitative research. Author past experience in shipping and transportation prompts acclimation of various phenomena of shipping and understanding the role of different actors in supply chain. Prior research has been done on certain parts of digitalization and technological innovation on shipping yet it needs research about on its interconnection with supply chain network and how innovation can enhance the entire business for future purposes. There are lot of vulnerabilities and uncertainties simultaneously prevailing around maritime industry, rise in financial development, expansion of import and trade and technological advancement is consistently demanding the transformation of rather much conservative maritime sector(UNCTAD, 2018). However, various laws and guidelines, constrained research, continuous fluctuations of economies, absence of government initiatives make it difficult for shipping to develop itself for modernization.

Due to such dubious scenarios and association of certain level of fluctuations **Inductive approach** is being chosen as methodology to base the research to create theories. It implies that research will extend from objectives to observation and depiction to breaking down the information to analyze the data and based on that analysis, research theory will be created.

The proposed research attempts to comprehend the human prospective in the interconnection between various areas, which is relentless with the inductive system as depicted by Saunders and as it will occur in one context that is shipping and its digitalization(Saunders, Lewis and Thornhill, 2009). The inspiration driving the research searches for in a general sense to make bits of knowledge which might be of some utilization The exploration may conclude up with specific proposals for further research in term of how the knowledge gained from this

research may achieve progressively more noteworthy dimensions of speculation and conviction.

Communication is the key embodiment of this research paradigm and as the procedure of research was inductive, thoughts are created, and classes were characterized along the procedure, as the information was gathered through discussions and talks with people in a fixed timeframe. In any case, being the author who was related with this industry for a long time, it was critical to be cautious with Bracketing, where the author has biased convictions and decisions dependent on their own understanding. To overcome this issue, open-ended questions were posed from members and personal interests and opinions were held during the meeting sessions, which may have impacted the speaker during interviews.

### 3.3 Research Design

The research design help researcher to enable to plan the procedure for data collection and to find most valid results.

### Research Strategy

It is an **exploratory research** for what it's worth about finding new aspects of development in shipping and incorporates the profound analysis of existing speculations and information to quantify the degree on future challenges and ebb and present status of shipping. This sort of research is critical in exploring new insights and questions with a different sight of perspective. As the exploration procedure is increasingly adaptable and gives an ability to alter the hypothesis and direction while doing research, it is advantageous(Saunders, Lewis and Thornhill, 2009).

The methodology that will pursue all through the research depends on already existing framework of shipping and experiments to implement innovation on maritime sector so far. Research dependent on **Grounded hypothesis approach** start with information gathering from self-perception, existing theories and future forecasts which is as of already existing from information and in research these hypothesis will be tested. In this research strategy despite the fact that there is generation of new theory yet entire base of hypothesis is as yet dependent on existing theory and available research on a given topic. According to Walsh et al 2015 as author is incorporating the grounded theory approach, the patterns emerging

through already available data will be studied and theories will be generated from that data(Walsh *et al.*, 2015)

The author of this research has considered several literatures comprising on existing research, scientific journals, blogs and current trends going in industry regarding adoption of innovation technologies. Additionally author had consulted with expert and researchers from respective industry to better understand the research topic and to figure out the gaps on which research need to be undertaken. Different domains of shipping have been taken together with in utilization of various areas of innovation and relative research had done to comprehend the future integration of the two components. In this research author collected and analyzed data from various shipping organizations, representatives, seafarers, speakers and tech organizations on the criteria based on interconnection between both innovation and shipping. Interviews conducted from correspondents from all these sectors and information was gathered based on services launched and effect of those services by tech organizations. Additionally the information was gathered from shipping organizations, logistics specialists on augmentation and reception of services given by tech organizations and their perception on how it is influencing on their present activities and what are the progressions technology brought which consequences for the manner by which procedure used to be conducted in past.

Conducting research on the basis of already founded theory and framework gave an advantage as it allows combination of different perspectives and data collection on the basis of an existing theory.

## 3.4 Data collection methods and sources of data

To gather primary and secondary information for research purpose, an approach of qualitative mono method of semi structured interview was taken. Primary data was gathered through personal interviews and the secondary data which was related to going on trends in shipping in context of adoption of technologies and their impact on supply chain was gathered through examination and evaluation of current news, blogs, scientific journals, seminars and initiatives taken by organizations. Because this research was carried out in limited horizon of time frame, accessibility and geographical distance, interview was

conducted through telephonic calls and electronic method of interview by using 'Whatsapp Call'. Interviews conducted were semi structured interviews with open ended questions.

A pilot interview was also conducted on sample of 2 people on initial stage of data collection which was beneficial in improving and analyzing the technical and content based issues with questionnaire. The main goal of pilot interview in research study is to test the suitability of the questions and in the smooth progression of discussion by refining the aptitudes of interviews(Abdul Majid *et al.*, 2017). The questions were discussed with supervisor and pilot tested on 2 participants. From the results of pilot interview ambiguity was found in one of the questions so that question was changed for better understanding of participants.

Interviews were carried out on sample of 6 people associated with shipping and logistics sector. Names of 6 participants were changed to maintain their privacy and confidentiality. 2 of these participants working in maritime sectors as seafarers and currently employed with shipping companies, working on container ships as marine engineer officer. These 3 participants are valid class 2 and class 4 grade licensed holders issued by Director General shipping of India and worked as 2$^{nd}$ and 3$^{rd}$ engineer officers on container ships. Other 1 candidate is ex seafarer and have 2 year experience in logistics industry and currently researcher in autonomous industry for maritime sector. All 4 of these have 3 -4 year experience with age span ranging from 25 to 29 as seafarers and highly qualified as graduated licensed holders' engineers. While the other participant are having researcher background and professor in colleges in the field of supply chain management and having extensive experience in the field of academic and research and currently working as assistant professor in Dublin City University. He completed his Masters in DCU and currently finalizing his Ph.D. on technology impact on health care systems. With around 5 years of experience including in IT companies in Asia, Australia and Ireland including Microsoft, he is monitoring the impact of digitalization on supply chain management closely and his teaching responsibilities covers broad range of areas in business and technology in strategy and supply chain management. Last candidate is working as global chief digital and information officer in world leading container shipping company. He has working experience of 32 years and responsible for adoption of digitalization in operation of his company. Due to geographical distance and limited time availability of participants all the interview have been commenced

through telephone and lasted for about 20-40 minutes. A consent letter along with interview themes and research objective was sent to all participants prior to interview assuring their consent and acquainted them with terms and conditions of data privacy and regulations. English was incorporated as medium of communication for taking an interview and was agreed by all participants. All the interviews were recorded after receiving participant consent in verbal form and later all the interviews taken were transcribed.

The technique of **purposive sampling** was chosen to identify sample of people for interview purpose. Since the research topic revolves around a specific sector and requires a sample of professionals having knowledge and experience in this specific sector so personal judgment was used while selecting specific candidates having a certain knowledge of research topic. Another advantage of using this type of sampling technique is it is time and cost effective and results in range of responses which is helpful in qualitative research(Lavrakas, 2008). As the research was academic and was conducted in a constrained time, hence horizon of time frame was **Cross sectional**. This study aims to depict the incidence of phenomena at a given point in time or to clarify how factors are connected in various associations(Saunders, Lewis and Thornhill, 2009).

## 3.5 Nature of data

The information accumulated was subjective, engaging and unprejudiced. In semi structured interviews, there's a possibility to test answers from interviewees where clarifications are required on their reactions(Saunders, Lewis and Thornhill, 2009). Thus, inquiries questions were raised with a goal to acquire however much data as could reasonably be expected from the interviewee without affecting them, to pick up a logical and elucidating information containing richness and context. The primary information gathered is the establishment of this exploration and as Saunders et al. (2009) clarifies, the key point is to keep up cohesiveness and wellness to the research aims. Interview subjects were built up ahead of time utilizing the conceptual framework and the discourse was mainly identified with those themes. Initially a set of pre-characterized themes were given to the participants with the goal that they could review and recall their experience and set up their reactions. The fundamental subjects were examined were adoption of technologies, challenges and restraints, initiative by companies.

However, moral issues were tended to while looking for answers. The kind of inquiries posed during the interviews was open-ended just as probing. To avoid the predisposition in meetings like the interviewer inclination where the tone or comments made by the questioner during the session makes an inclination that causes the interviewee to react in the manner the interviewee needs (Saunders, Lewis and Thornhill, 2009) the questioner avoid their comments and perceptions all through the meeting to abstain from controlling the member with their views on the issue. This was finished by asking open-ended questions to the participants, keeping their tone impartial and giving them an opportunity to develop their reactions without meddling them.

## 3.6 Access and Research ethics issue

In order to build up the coherent research it is most extreme imperative to arrive at the correct sources for primary and secondary information. During qualitative research, author has huge obligation due to its contribution from structuring to reporting as far as secrecy, obscurity, informed assent and so on(Sanjari *et al.*, 2014). Author of this research contacted with individuals in shipping, logistics, port and tech area because of its system and past experience. Author made sure that respondents will be obliged to being honest and consequently they have appropriate to keep up their privacy and classification and have ideal to decline to address any inquiries. This was finished by sending a form of consent to respondents before gathering any information for examination and sending them a short clarification of point previously. The research had commitments to remain honest to inquire about and ought not abuse any data acquired during meetings and information gathering.

## 3.7 Approach to data analysis and interpretation

As indicated by Saunders et al. (2009), the gathered information ought to be examined effectively to be important and comprehended. Subsequent to leading every one of the meetings, the information was set up for investigation. The procedure included deciphering the sound recorded information into composed structure, making an interpretation of it into English and rehashing the contents to distinguish composed mistakes. In the interpretations, inquiries questions were appeared in italics while the reactions were in typical textual style. The information investigation strategy connected in this exploration was 'Coding and Thematic Analysis'. This strategy included arranging information by determining classes which were connected to the theoretical structure. Every class or topic recognized was given

an extraordinary shading and truncated code. The motivation behind coding is to relate topics in the information gathered and the examination hypothesis to make inferences.

At last, the concluded information was analyzed by following three procedures summarize, form categories and structure meaning using narratives(Saunders, Lewis and Thornhill, 2009). The procedure of understanding included qualitative information, identifying themes and key ideas, associating them to theories found in literature review and theoretical structure, recognize relationship among topics and hypotheses and in conclusion draw results.

## 4.0 Discussions of Findings

The data collected analyzed in following chapter was gathered through semi structured interviews with candidates linked with shipping and logistics industry and related with applications of digitalization in my case study. The questions asked in interview were open ended in nature to ensure collecting rich and elaborative information from the candidates. The data gained through this interview was descriptive in nature and issues and initiatives are pointed by participants are overlapping and as well as the challenges that occur with digitalization. The sample size of 6 participated in the interviews to explore the grounded theory of application of digitalization in maritime logistics industry with work experience vary from different fields associated with maritime industry ranging from technology experts to seafarers. Work experience of these participants ranging from 2 to 15 years. Details of the participants are shown below:

| S.no | Participants | Education Qualification | Current Position | Experience | Type of Interview |
|---|---|---|---|---|---|
| 1 | Mac | Masters in E-commerce | Assistant Professor in DCU | 5 years | Telephonic/ 35 mins |
| 2 | Sim | Masters | Global Chief Digital & | 32 years | Written |

| | | | | | |
|---|---|---|---|---|---|
| | | | information officer in shipping company | | |
| 3 | Ion | M.Sc in Autonomous systems, Masters in marine engineering | Research assistant and data scientist in Aalborg university | 2 years | Telephonic/ 35 min |
| 4 | Yat | B.Tech in Marine engineering | Class 2 engineer with Anglo eastern | 5 years | Telephonic/ 33 min |
| 5 | Ved | B.Tech in Marine Engineering | Class 4 engineer in Fleet management, Logistics & inventory officer in Valad Infotech | 5 years | Telephonic/ 34 min |
| 6 | Spa | MBA , B.Tech in marine engineering | 3rd engineer in United Ocean management, Logistics & inventory officer in Valad Infotech | 5 years | Telephonic/ 35 min |

**Table 1 : Description of Candidates**

The process of data analysis involves the coding process in which color codes were used to highlight similar points highlighted by all the candidates in their respective interviews which were then classified together under one theme. Total 5 themes were classified and which were interlinked with each other in conceptual framework along with the literature review which was carried out for all these themes. These themes along with their respective codes are shown in table below. The aim of doing a qualitative interview to explore the aspects of digitalization on the maritime and logistics sector and its effects on the overall efficiency of supply chain and logistics industry.

| Themes | Code | Color Coding |
|---|---|---|
| Initiatives by Companies | IC | |
| Scope of digitalization | SOD | |

| | | |
|---|---|---|
| Technologies & their applications | ET | |
| Challenges of Digitalization | COD | |
| New market and Service providers | NM | |

Table 2 Themes Description and color coding

## 4.1 Findings

In this section, the themes which were identified during the data analysis of qualitative interviews are described. First, the content of each theme will be described along with the interviewee statements in the form of quotations and later on it is followed by critical analysis.

### 4.1.1 Initiative taken by companies (IC)

The color coding of these theme is green and its abbreviated code is IC. As mentioned in literature review, digitalization is spreading its impact on the entire sector eventually and maritime industry is one of the sectors where there is huge scope of digitalization. Shipping sector is considered as somewhat conventional sector with regards to adoption of technologies. But recent initiatives taken by companies and applications incorporated in shipping is beginning to revolutionize the industry as stated by Sim,

"We are living in an increasingly digital and on-demand world, and the customers are pushing the industry to modernize processes and offer a higher digital support. Hence, evolving towards digitalization is not a matter of choice anymore *and shipping companies have realized that they are lagging in terms of technology comparing to other sectors. Nevertheless, some steps have been taken towards digitalization* and industry standardization leading to increased interoperability. There is still a long way to go and the key to achieve faster results is the cooperation among the participants contributing to set higher level of standardized processes"

*Sim, Global chief Digital & information officer in MSC (Mediterranean Shipping Corporation). MSC is a world 2nd largest global container shipping company*.

As stated by Mac, because of the advantages of digitalization, companies are keen to adopt the technologies and companies which are adopting the technologies will be having competitive advantage then those which are not adopting

*Changes observed in supply chain by digitalization will be similar to changes observed in other industries but might be seen first in supply chain before other industries. Technology can automate the process of data entry by sharing the data bases from company to company so company can access on what the level of supply they are at. The best example of companies that are adopting blockchain technology at least for present time now is MAERSK. Blockchain has brought down lot of transparency and reduced basically time to conduct the business.*

*Mac, Masters in E-commerce, Assistant Professor in DCU*

Continuing the previous statements Yat stated that shipping companies are operating on global level and interconnected with each other but still not operating in same level in context of adopting innovation

*Although shipping is a industry operating in global level, still it is conservative in nature in context of adoption of new technologies and integration of systems which are adopted worldwide. In terms of technological advancement, shipping companies are not operating in similar framework although in context of cargo operations, often they are interconnected in operations but the level of standards they are operating is far different from each other which is dependent on many factors like how big company is, geographical area in which company is operating, compliance of laws and regulations.*

*Yat B.tech In Marine engineering, Class 2 engineer in Anglo eastern shipping company*

Countering the statements by Mac, Ion suggested that companies are still slow in adoption of these technologies and waiting for the end results :

*It started very slowly in beginning compare to other industries but right now every year as time passes it is getting faster and faster and it transform the operations of big companies. So companies knows what is happening and what are the possible benefits of using these innovations and technologies but they are still waiting for the end results in terms of value to become part of this*

*Ion Master in Naval architect and marine engineering. M.Sc. in autonomus systems. Research assistant in Aalborg University*

Supporting the statements by Ion, Spa suggests that companies are slow in upgrading their whole process and focusing more on upgrading their fleet to optimize their operations

*So far companies are more tend to invest in upgrading their vessel fleet, for instance advance mechanization and machineries onboard, highly connected navigation systems, machineries to assist faster cargo operations etc. these investment are mostly motivated by compliance of laws and regulations or tendency to increase their company own efficiency but development of whole sector is still limited in nature. Not much of change has occurred so far and whole shipping process is still in ropes with long paper trails, custom issues, middleman and agents and still nothing*

*disruptive change has brought by shipping. Containerization was the last disruptive change that was implemented in shipping*

> *Spa B.tech in Marine engineering, Class 4 engineer with United ocean shipping. Masters in International business, Logistics and inventory specialist in Valad Infotech Mumbai*

While view of few participants were in favor of that sufficient initiatives taken by shipping companies, Ved statements were more of neutral as it suggests that

*Development of new technologies and innovation is still in its initial phase and still there is long way to go before any significant change will be observed on shipping and overall logistic industry. Although companies are increasingly adopting automation and in some domains of shipping & logistics there are experiments going on to test the full extent of digitalization but to cover the whole maritime industry and other processes associated with it, it is still going to take some time and lot of resources will be needed to transform the whole operation*.

> *Ved, B.tech In Marine engineering, Class 4 engineer, Logistics and Inventory specialist with Valad Infotech Mumbai*

The contradictory point of view of above participants regarding the current and future extent of digitalization on shipping presented an argument which can be interpreted as that process of digitalization and digital transformation of operation processes is underway in maritime sector and currently its in its initial stages, where most of the organizations are waiting for setup of a stable platform of digitalization and still in process of analyzing and assessing the results obtained from initial experiments and initiatives. As stated in literature review that major breakthrough has happened recently only where MAERSK in collaboration with IBM launched a blockchain initiative and few of the leading global container companies have joined that initiative to use a common platform. Although digital transformation of maritime sector is underway from quite some time and as defined in literature review, there is difference between digital transformation and digitalization. Shipping companies are transforming their operations digitally by data sharing and with the advancement in satellite technologies are allowing the transfer of massive amount of data at very low costs, ships are becoming advanced and equipped with hundreds of sensors providing real time information and converting into data generators(DNV GL, 2018). By looking at the current profile of participants it can be observed that they are currently working in maritime and logistics sector in a good responsible position and their job profile vary from on shore employees

administrating digital transformation to the seafarers that are experiencing the real time development occurring in industry and where it is leading the future of shipping.

### 4.1.2 Scope of Digitalization on shipping

The color coding used for this theme is purple and abbreviation code used for this is SOD. The scope of digitalization of shipping is another issue that has to be considered to understand the extent of digitalization of maritime sector by shedding the light on significance of digitalization on maritime sector. Earlier Shipping was considered as conventional sector with limited intervention of technology in its operations with standardization of containers as the most disruptive change so far but with the innovation and advancement of technologies there seems to be introduction of numerous applications where technology can replace the conventional framework(Fruth and Teuteberg, 2017).

As stated by Sim regarding the extent of changes which can be observed in future in maritime and logistics industry by adoption of these technologies are as follows:

New accessible platforms have been designed for all shipping and logistics providers. For instance, recently we have joined a digital shipping platform using blockchain technology called Tradelens, which will enable the exchange information and visibility between customers, carriers and all the main participants of the sector. Another example is the smart container, that illustrates the big change going on in our industry. A standard container fitted with a Traxens device, which monitors position, movement, temperatures, shocks and reports back information.
From a future perspective, the processes will be more efficient and streamlined and complexities in the logistics supply chain will be reduced.

*Sim, Global chief Digital & information officer in MSC (Mediterranean Shipping Corporation). MSC is a world 2nd largest global container shipping company.*

As Sim described the applications of digitalization on ships and how it will effects the future of shipping Mac states about the application of blockchain and internet of things on supply chain and logistics industry:

Blockchain has brought down lot of transparency and reduced basically time to take the business. Once upon a time it used to take couple of days to do paper work to send goods from south east Asia to north of Europe, this paper work become automated because of blockchain technology and therefore it is speeding up the process and goods are travelling quicker than before.

Live data relating to refrigeration in transport of food stuff and that is having very great impact on cost savings. Technologies like these have great impact on customer relationships and these technologies swill have massive impact on consumer experience.

*Mac, Masters in E-commerce, Assistant Professor in DCU*

Supporting the comments stated by Mac, Yat further elaborate the scope of digitalization on shipping and maritime sector as:

There will be increase in efficiency in terms of speed of carrying out business activities, increase in transparency through end to end customer visibility, reduce in human error, Better real time information will improve whole infrastructure where shipping works.

As shipping is integral part of supply chain and major percentage of share of cargo moving is through shipping. With advancement in cargo moving and with increase in connectivity among all the elements of supply chain through technologies like blockchain and internet of thing, there will be drastic increase in overall efficiency of whole supply chain network. It will result in cost saving to fright movers and better customer service for customer end.

*Yat B.tech In Marine engineering, Class 2 engineer in Anglo eastern shipping company*

Ion is further explaining the applications of digitalization on fleet of ships and during thew cargo movement from one port to another

In future and near future there will be mass reduction in burecarecy by reducing the paper work. Everything will be done online from booking to insurance, trading and involvement of human will be reduced drastically. Just like other industries where ecommerce platforms has dominated the field it will happened in shipping industry as well as everything will be faster and smarter for instance during port calls when will vessel arrive, is there any bunkering supports available already and other services like how many tug boats will be required to support the vessel all these will be automated.

*Ion Master in Naval architect and marine engineering. M.Sc. in autonomous systems. Research assistant in Aalborg University*

Discussing the applications of technology on shipping, Spa suggests

Digitalization will impact immensely on connectivity by interconnecting all the actors of maritime supply chain together by boosting the real time data sharing and storing between them. These includes shippers, freight forwarders, logistics providers and end customers. This real time connectivity and information sharing will help them to use their resources more efficiently by better predictions. Smart ships with sensors and suitable networking information systems there is

possibility to connect global network of marine transport and it will ultimately result in transparency and significant cost reductions.

*Spa B.tech in Marine engineering, Class 4 engineer with United ocean shipping. Masters in International business, Logistics and inventory specialist in Valad Infotech Mumbai*

Talking about the idea of connectivity by digitalization on inland shipping of Ved suggests that:

With the application of digitalization, new supply chain models can be made in which optimized mode of transport and selection of routes can be combined together based on real time information for instance availability of rail cars, inland ships and dependency on the availability of these modes can be known beforehand which can result in better utilization of transport modes for deliveries.

Moreover the transfer of information within different players of supply chain which generally takes long time in form of long paper trails and approvals can be omitted by introduction of smart contracts and instant data visibility from one end to another end will increase transperancy and visibility and ultimate can lead to faster optimized shipping process.

*Ved, B.tech In Marine engineering, Class 4 engineer, Logistics and Inventory specialist with Valad Infotech Mumbai*

By interpreting the different viewpoints of candidates, it can be manifested that there is huge scope of digitalization and its applications on overall shipping and logistics in terms of increase connectivity, visibility, data sharing and real time information. As found in literature review that shipping of goods holds major proportion in whole supply chain network and optimizing the shipping through digitalization will have immense effect on increasing the overall efficiency of supply chain. Technological innovations and its applications are spreading its footprints in all industries, however in shipping which is an integration of different actors that are interdependent on each other for eg. Port, freight forwarders, ships there is huge possibility of optimizing the operations by intervention of these applications in each individual players and connected them to gain better control, visibility and transparency over supply chain network.

### Emergence of new technologies ET

The color code for this theme is grey and abbreviated code for this theme is ET. To better understand the impact of digitalization on maritime industry, there is need to learn about new technologies which are all set to revolutionize the industry. There are three aspects of innovation in technologies i.e digital transformation, digitization, and digitalization. As explained earlier in literature review there is difference in approach and adoption of technologies sin all these three developments. These new technologies impacting each element of shipping in their own way, for instance advancement of port infrastructure by using autonomous vehicles, connected ports, real time information of ships and cargo, draught and weather predictions where as on ships it is mostly related with advancement of machineries, navigation equipment's onboard, weather forecasting, voyage data recorders. So applications like blockchain technology, internet of things, big data are few to be named developing to collect information from all these elements to analyzed and store them to interconnect all these elements to form a single framework in which whole maritime and logistics sector will operate. Describing about current technologies which are emerging in market to change the future of shipping SIM states:

Technologies as cloud computing and Blockchain have the ability to help transformation within maritime sector. Nowadays, many parties (terminals, carriers, customs, etc.) exchange information through various channels, which leads to delays, misunderstandings and other complications. Thanks to Blockchain technology parties involved in shipping will be able to share information through a secure, transparent and trusted way, which has the potential to enhance the information accuracy and to reduce the processing time. Other technologies like IoT, enable the tracking of goods and offers to the customer real-time visibility sensitive shipping information, such as cargo location, temperature and handling processes, that empower carriers to increase the trust relation with the end customer.

*Sim, Global chief Digital & information officer in MSC (Mediterranean shipping corporation). MSC is a world 2nd largest global container shipping company*.

Adding to the above comments stated by Sim, Mac is describing about the nature of other technologies then blockchain and Iot and their applications which represents the change in customer behavior

There are two things that are particularly stand out, they are not new but they are new in these areas and slowly getting widespread. 1 is simple act of location of real time data where the product is , all these technology doesn't need to have part of blockchain they can be independent of it and

another is very nature of live tracking of your product add a new relation with me a a customer so I now have experienced the real time tracking so I only want to use that now and I am not going to use another one.

*Mac, Masters in E-commerce, Assistant Professor in DCU*

Focusing on the investments being done by companies to minimize the risks associated with machinery failures and optimizing the containers to maximize the usage of empty spaces, ion suggests:

A lot of money has been put in programs like predictive preventive maintenance system and companies like Wartsila and Man B&W are spending money to make it as efficient as possible because breakdown of any machinery can cost a lot of money to ship owners so this is one fields and other field is blockchain technology which is delivered through consulting companies like software companies like IBM. With container companies they will have real time information of their container. Another trending technology is Efficient Empty container repositioning by Boston consulting group. 1/3rd of containers are moving empty and ships need to move where they are for loading purposes. This is actually was very big issue at start of container shipping and now with this tool it can be optimized.

*Ion Master in Naval architect and marine engineering. M.Sc. in autonomous systems. Research assistant in Aalborg University*

Yat discussing the new technologies that are in experiment phase and some of them being implemented on some levels in different sectors of maritime industry such as

I believe other than blockchain technology and internet of things which are being used to store and share information and increasing connectivity and providing real time information there is huge scope of some other technologies that are being looked as future to revolutionize the maritime industry.3 D printing is one of them which is being implemented by many companies in their testing phase in order to provide spare parts and stores readily available in case of major or minor breakdown. Other big thing is autonomous vessels which are centrally controlled and currently in testing phase in inland waterways in Norway.

*Yat B.tech In Marine engineering, Class 2 engineer in Anglo eastern shipping company*

Talking about automation, spa further supporting the comments of Yat, stating that:

Automation is being used in many ports currently for instance port of Antwerp, port of Rotterdam which are full automized and become successful in increasing their overall capacity of handling cargo. Moreover using of big data is not just limited to IT sector now, its applications are being incorporated in shipping industry as well. Ships are becoming center hub of information and likewise ports and freight forwarders are also advancing their operational infrastructure so integration of all

this data together is being used to access and analyze the real time information of events and ultimately it results in optimizing the usage of resources.

*Spa B.tech in Marine engineering, Class 4 engineer with United ocean shipping. Masters in International business, Logistics and inventory specialist in Valad Infotech Mumbai*

Ved describing the situation of conventional shipping framework and stating that:

With the flow of so many data and information between ship owners clients and freight forwarders and long paper trails requires time and adequate storage for easy accessibility and avoiding loss of data. Cloud technology is being a milestone in for easy access of data regardless of time and location. It is offering better communication, cost savings and data loss prevention.

*Ved, B.tech In Marine engineering, Class 4 engineer, Logistics and Inventory specialist with Valad Infotech Mumbai*

As stated by different participants there are numerous technologies which are being focused upon to bring concept of digitalization into reality. The maritime industry has always been operated with efficiency but being reluctant to adopt emerging technologies which can be disruptive to logistics framework but with growing consumer demands and need for sustainable future created a phenomena that maritime industry has to take advantage of new technologies(Madden, 2017). These new technologies as stated in literature review bring forward the concept of digitalization on maritime industry and creating a wide scope of extent of digitalization of maritime industry.

### 4.1.3 Challenges of Digitalization

The color code of this theme is sky blue and abbreviated code for this theme is COD. With the development of technologies as described in above theme depicting the new technologies and advantages that is bringing along with it. But along with the numerous advantages there are challenges associated with it too. These challenges are ranging from security issues to adaptability of this technology due to stringent framework in which shipping operates. Other than that there are challenges which can emerge because of difficulties due to integration of technologies with the conventional logistic framework. As

discussed with participants many challenges were pointed out during an interview. Discussing the challenges and restraints of digitalization Sim suggests

We need digital standards to enable full implementation of the technologies along the industry. As we evolved, interlocking parts began using different communication formats and protocols and the system became very complex. Recently major carriers have created a new container line association (DCSA) aiming at collaborating on industry digital standards. The purpose is to pave the way for interoperability through digitalization and standardization and create sstandard ways to talk to each other, implementing online exchange of information under globally agreed-upon standards from everything like location codes to regulatory definitions.

*Sim, Global chief Digital & information officer in MSC (Mediterranean shipping corporation). MSC is a world 2nd largest global container shipping company.*

According to Mac speaking about challenge will not just limited to operationalization factors of technology but also extend to external factors like loss of jobs:

Now the other challenge is you don't have to need as much of people as it usually required so speaking about challenge is you going to face either redundancy or companies are more proactive they have to up scaling their workers but it depend from companies to companies so generic answers to this question is some people are going to lose the jobs secondly company will invest in their current employees and make them ready for new style of business and whether companies will do that it is totally the subjective question that whether companies will do that vary from company to company.

*Mac, Masters in E-commerce, Assistant Professor in DCU*

Talking about dangers regarding cyber security and reformations of regulatory framework to make space for this new digitalization Ion suggest:

In terms of autonomous shipping there are still things which needs to be regulated obviously we are not every close to having fleets of autonomous ships right now but we have still small research vessels which are working and in that arena there needs to be regulations which needs to come before launching along with that service companies like insurance companies need to be ready as well. There are lot of big cyber security companies which are still in process to find solutions and the giants companies need to be careful for their data security on both vessel and onshore.

*Ion Master in Naval architect and marine engineering. M.Sc. in autonomous systems. Research assistant in Aalborg University*

Supporting the comments of Ion, Yat suggests that:

Regulatory framework needs to be changed to make space for these technologies in case of autonomous vessels as it can affects the laws like SOLAS ( Safety of life at sea). Another major issue is cyber security, with the flow of such sensitive massive information there is always a risk of cyber security. Lack of proper security measures can endanger the flow of information and can cause leaks of data.

*Yat B.tech In Marine engineering, Class 2 engineer in Anglo eastern shipping company*

Supporting the comments of Mac regarding the loss of jobs Spa describe the current situation that:

With increasingly automation processes there is always danger of losing of jobs as we can see in shipping industry where crew of ships are being reduced with increasing automation and minimum manning is being maintained. Another aspect of restraints is ownership of data as one software company will be offering data to numerous clients there could be problem arises of ownership of data and moreover the confidentiality of data.

*Spa B.tech in Marine engineering, Class 4 engineer with United ocean shipping. Masters in International business, Logistics and inventory specialist in Valad Infotech Mumbai*

Talking about the global spread of digitalization as a challenge ved describes:

We see digitalization as new concept and its applications are spreading on different levels of supply chain network but still there is long way to go for global acceptance of digitalization. Since it requires lot of research and restructuring of whole framework, so companies with less resources or operating on small scale will be having difficulties to adopt these technologies and ultimately it will effect on overall integration of framework between companies.

*Ved, B.tech In Marine engineering, Class 4 engineer, Logistics and Inventory specialist with Valad Infotech Mumbai*

As described by participants and interpreting their notion it can be concluded that inspite of various opportunities and benefits that may come along with the digitalization there are still some challenges which needs to be considered. Some challenges need to be tackled beforehand in order to global adoption of these technologies and few challenges like cyber security will come along with as more and more technology will be adopted. Strong

security measures will be needed to develop alongside and regulatory framework have to be restructured to suits the requirements of digitalization.

### 4.1.4 Emergence of new markets

With development of technology and innovation and increasing scope of digitalization on shipping industry, there is development of new markets and third party service providers which can facilitate the services to maritime industry. For instance IBM an IT company collaborate with MAERSK, similarly there are companies and organizations which are doing research and development program to develop and test the technologies for maritime industry for eg, Xenata, Freightos, Flexport, Fourkites.inc are named to be few which are providing blockchain based services to shipping companies and most of these companies have been established in recent years only.

Sim explained about the new markets and opportunities that are developing with introduction of these technologies as:

> Technologies could bring several opportunities, especially in terms of process optimization. Automated services will enhance the speed and quality of operations, to offer a better end to end service for the customer. Integrated services can increase customer satisfaction and by that mean create customer loyalty. In terms of new market opportunities, technology will enable even safer shipping than today. Smart containers monitoring the quality of the good and transmitting live information to the customer creating more transparency to some specific industries such as pharmaceutical and other markets related to food safety.
> Companies that now have more visibility can foresee how to act on the market and may propose to their clients, services based on data collected and analysed.
>
> *Sim, Global chief Digital & information officer in MSC (Mediterranean Shipping Corporation). MSC is a world 2nd largest global container shipping company.*

Further adding the point stated by Sim, Mac suggests that about advantage for small companies

> There is massive potential with anytime there is major change in industry, one of the big opportunity is for smaller companies to come in and facilitate the change to act as a consultant. There is good opportunity for middle service providers.
>
> *Mac, Masters in E-commerce, Assistant Professor in DCU*

Supporting the comments of Mac, Yat is pointing on the significance of service providers

Yes there are and there will be service providers that will facilitate these technologies to clients either with direct collaboration or provide a common platform with which all the companies can affiliate with.

*Yat B.tech In Marine engineering, Class 2 engineer in Anglo eastern shipping company*

This is common phenomena in industry that when there is launch of something new which have capabilities to revolutionize the market, the players which adopt that on earlier stages will have competitive edge over others and can provide such services to other companies on later stage. There are always service providers that come into play to gain the advantage of early market opportunities that will be seen in maritime industry.

*Spa B.tech in Marine engineering, Class 4 engineer with United ocean shipping. Masters in International business, Logistics and inventory specialist in Valad Infotech Mumbai*

Describing the current scenario of shipping, Ved suggests

Shipping is associated with interaction of multiple actors at same time providing services to each other. But if we see the increasing impact of digitalization we can understand that market scenario is changing. There is tendency of companies to outsource their services to increase productivity and speed up the process. Working as logistics consultant, our company is providing services to shipping clients to manage their inventory network which was earlier done by companies own employees. So we can see there are massive future opportunities with increase in digitalization.

*Ved, B.tech in Marine engineering, Class 4 engineer, Logistics and Inventory specialist with Valad Infotech Mumbai*

Interpreting the statements by participants, a notion can be created that digitalization is not just limited to shipping and its associated players but also it is able to create opportunities for players which are being considered as outsiders so far in maritime industry such as IT platforms. As mentioned above that there are already starters present in market which are providing services to shipping companies by combining information technology with logistics so as to provide services like real time information and data handling and storing.

## 4.2 Discussion

The verdicts that are derived from the findings interviews in previous sections will be discussed in following section.

Firstly it is summarized that digitalization is not merely a concept anymore but it is shaping in reality now. There is huge scope of digitalization on different aspects of shipping and future of logistics and maritime industry is in integration of both sectors with interlinking through connecting applications like blockchain, IoT and big data. It has been found that shipping, logistics and port infrastructure are evolving from a conventional framework on their own pace, each sector is advancing within itself by adoption of innovation and digitalization but future lies in integration of all these sectors together to form a digitalize supply chain network. This network comprises of connected elements of supply chain sector within maritime industry by the means of streamline flow of information and data within each other.

Shipping companies are somewhat inclining towards adoption of these technologies and currently in process of analyzing the results in values from initial phase experiments. Depending on resources for research and developments, few companies are taking initiative to create platforms using such technologies and so far they have been succeeded in creating a collaboration of not only with other container shipping lines but also with port services and custom authorities to create a common database which is accessible to all the stakeholders. These common platforms are providing the information on real time activities and help in coordinating of operations with adequately using the resources accordingly.

Shipping and logistics sector is creating opportunities to make way for new technologies that can replace the conventional framework with new digitalize network. Technologies like blockchain, internet of things have already impacted the sector considerably and their applications are already incorporated in operational levels. Connectivity of sensors onboard, real time tracking of cargo location, empty container repositioning system, controlling and monitoring parameters of goods is being centrally controlled and is prime example of applications of Internet of things. Augmented reality and virtually reality was being used in past in real time simulators for training purposes but these are now being incorporated with collaborations of satellite technology to predict the future events like weather forecasting, navigating through channels and calculating ships loading and unloading times. Cloud computing and big data is another major applications which are being used on basic level to store and transmit data resulting in increase in accessibility.

Along with applications of digitalization there are challenges and restraints as well which needs to be overcome to create a digital network and fully incorporate the applications of digitalization on maritime industry. One of the biggest hurdle as stated above is integrating all the player on common platform as shipping operates on global level and at one point there is interaction of many stakeholders which are operating on their own regulatory framework. To ensure the adoption of these innovation on same level there are challenges like confidentiality among competitors on organizational and national level. Other considerable restraints is risk of cyber security, with the immense flow of information and data accessibility by all actors there is always  a risk of cyber security, as just one malware can affect whole foundation of digital network. Another challenge is to ensure that companies with limited resources may not be able to tackle with the companies operating with huge resources and there could be chances of monopoly in market.

Considering the opportunities provided by digitalization there is future of developments of new markets in near future which can provide services to different stakeholders and facilitate the operations through digital network. These companies are already in operation and as found in interviews can be a medium for small scale shipping companies to operate and integrate with operational structure of big companies. There is another finding that there are opportunities for companies that are starting their businesses to adopt these technologies in their operational framework on initial stage only and can benefit in long term by being ready for future.

Lastly concluding this chapter, the identified themes during the discussion and analysis when assessed deeply show that there is interconnection and interlinking between all the themes for instance for digitalization of maritime sector, there is a need to understand the extent of scope of digitalization on shipping industry and its logistics part. Initiatives taken by companies and emergence of new technologies will help in emergence of new markets and service providers. Along with that there will be challenges and restraints will come which needs to be overcome for widespread of this phenomena on shipping sector.

# 5. Conclusion

This chapter is focused on the summary of main findings and their implications on research questions. Along with that recommendations and limitations and contributions will also be mentioned that researcher faced while carrying out this study. This chapter also includes suggestions and recommendations for further research in the respective area for people and organizations associated with this sector.

## 5.1 Implications of Findings for the Research Questions

As indicated in previous chapter it can be analyzed that qualitative analysis of this research was found beneficial in deriving findings as it helps in better understanding the extent of digitalization and digital transformation of shipping sector from its conventional image. Research questions for this study revolve around the idea to explore the impact of innovation on maritime sector. As maritime sector contribute to major share of supply chain network and consist of complex flow of commodities so to understand that how digitalization and innovation can optimize the functions of maritime and logistics sector to increase its efficiency this research was carried out. Various studies have been conducted in past to understand the changes that are being observed presently and in near future but through qualitative study like this, researcher was able to better understand that how digitalization is affecting on shipping sector.

The findings from this research focused on different aspects of effect of digitalization by understanding the initiatives taken by industries which lead to what is the scope of digitalization on shipping and challenges and opportunities associated with that. From the findings it was evident that phenomena of digitalization is gaining momentum inside the shipping industry already and measure are being taken by companies to transform their operational structure towards digitalization. Big container liners like Maersk, CMA CGM , MSC are named to be few which are coming together on same platform to embrace the services gained by applications like blockchain and internet of things. Apart from that ports like port of Rotterdam and port of Hamburg one of the largest ports in worlds have automized their operations to great extent and benefitting from increasing connectivity and real time information between cargo operations. Moreover there is considerable development has been observed during research in emergence of service sectors which are facilitating digital services to maritime sector to make them more connected and optimize their operations by the use of applications of digitalization.

## 5.2 Contribution and limitations of research

As explained before maritime sector is operating globally with complex interaction of shippers, freight forwarders, port authorities and custom authorities of different nations globally. Although it is operating globally, few nations are leading in terms of ship manufacturing, research and development of technologies and advancement of shipping infrastructure.

In my perspective the contributions made through this research was to better understanding the aspects of different shareholders of shipping and how this industry is growing from a rather conservative sector in context of disruptive logistics framework to a digitalize interconnected industry. There has been lot of talks among the shipping professionals for changing scenarios of shipping and predictions which are going to change the recent future of shipping. There is continuous updated information are getting available through blogs, news and shipping journals and which is limited to shipping circle only but through this study researcher has tried to shed a light on critical literature to explore the extent of digitalization on maritime industry and its associated elements like logistics and changing port infrastructure.

However some limitation has been faced by researcher while conducting this study which restricted the researcher and limit the scope of study. As the dissertation process has limited time constraint which affected the objectives to be very precise and focused so that it can accomplished in specific span of time, which limited the researcher to understand and explore other potential stakeholders of this sector. Secondly, as the research study was being conducted on undergoing impact of digitalization on industry which is on initial stages and distributed over whole shipping and its stakeholders, it limits the researcher to capture the end result of this impact and to better understand the future challenges that could occur in future. Also, due to geographical distance and time constraint the process of data collection was complex. As it is being initiated by few companies and authorities, author tried to take views from participants from every element but only limited amount of data was collected to understand the idea of digitalization. Moreover as researcher was not physically present at the location so it was difficult to approach the participants. Along with this some of the issues faced during collecting data was unavailability of participants,

unwillingness to share details and information and also turning down of interview after commitment. Lastly, due to limited experience in carrying out a research, time management was one of the issue that researcher faced during conducting this research.

## 5.3 Recommendation for practice

This section provides set of recommendation on practice side for all the stakeholders in shipping and logistics industry which could aid in creating a better digitalize framework for future.

The recommendation is directed to the shipping professionals and governing bodies that as it is a global industry so advancement in its structure will not be truly possible until all there is equal contribution from all the stakeholders from different part of worlds. If it is to become a reality to make a digital shipping network there is need to undertake the consideration for underdeveloped countries and small ship scale ship owners that are still operating in conventional framework of shipping and there is not much development is been done in those countries.

Second recommendation is directed to ship owners that while undertaking transformation of shipping into digital network there is need of strong cyber security measures to be put in place beforehand to ensure prevention of data leaks and confidential information.

The third recommendations is directed towards researcher and shipping professional that since digitalization of shipping is in its initial phases and there is uncertainty regarding future of shipping and logistics industry there is limited amount of literature available in this arena to better understand the overall concept of effects of digitalization and what is there and what is missing.

## 5.4 Recommendations for future research

This section describes the recommendations for future research work in the field of shipping and logistics industry. Due to the time constraints and lack of resources, the research was limited to explore the extent of digitalization on overall shipping process. However if provided with sufficient time and access to resources, further research can be carried out on individual elements like service provider companies, ship owners and logistics handling

companies to understand the impact of applications like block chain, IoT and big data on their processes.

Moreover there need to be further research to be carried out in the arena of labor markets as developments of these technologies can lead to loss of jobs of workers which is already being seen on ships where ship crew are being reduced to reduce costs and it is being replaced by automation. Research needs to be carried out to develop ways to not to reduce the jobs but how to upscale the workers to fulfill needs of future.

Shipping is considered as the cheapest but also the most polluted means of transport of cargo. Although there are already numerous laws and regulation regarding environment which need to be comply by ship owners to run their ship fleets and it is already putting up pressure on ship owners. Further research can be carried out on how digitalization can make way for sustainable shipping and logistics network.

## 5.5 Final conclusions and Learning

This section includes the recap of final chapter of research elaborating how the findings of research were beneficial for the maritime and logistics sector and what are the contributions that were made through this research. The chapter also showed how the recommendations made in this chapter can be used practically by industry stakeholders and provides further assistance and support in future research in this respective sector. The recommendations were directed to ship owners, researchers, ship professionals and governing bodies like IMO and UNCTAD stressing over the prominent role that they can play in optimizing the transformation of shipping sector into a digitalize network. For future research, the subject of effects on labor market and jobs due to digitalization as well as how digitalization can help shipping organizations to make their ships more sustainable in future can be explored.

# 6. Bibliography


Abdul Majid, M. A. *et al.* (2017) 'Piloting for Interviews in Qualitative Research: Operationalization and Lessons Learnt', *International Journal of Academic Research in Business and Social Sciences*, 7, pp. 1073–1080. doi: 10.6007/IJARBSS/v7-i4/2916.

Abdul Rehman, A. and Alharthi, K. (2016) 'An introduction to research paradigms', 3.

Accenture (2016) 'Digital Transformation of Industries', p. 16.

Adom, D., Hussein, E. and Joe, A.--A. (2018) 'THEORETICAL AND CONCEPTUAL FRAMEWORK: MANDATORY INGREDIENTS OF A QUALITY RESEARCH', *International Journal of Scientific Research*, 7, pp. 438–441.

ATKearney (2015) *Read @ATKearney: Digital Supply Chains: Increasingly Critical for Competitive Edge*. Available at: http://www.atkearney.com/operations-performance-transformation/article?/a/digital-supply-chains-increasingly-critical-for-competitive-edge (Accessed: 25 February 2019).

Awad, H. and Nassar, M. (2010) 'Supply Chain Integration: Definition and Challenges', *Lecture Notes in Engineering and Computer Science*, 2180.

Baldauf, M. *et al.* (2018) 'E-NAVIGATION, DIGITALIZATION AND UNMANNED SHIPS: CHALLENGES FOR FUTURE MARITIME EDUCATION AND TRAINING', in. *12th International Technology, Education and Development Conference*, Valencia, Spain, pp. 9525–9530. doi: 10.21125/inted.2018.2374.

Bhardwaj, S. (2013) 'Challenges and potential of technology integration in modern ship management practices', p. 315.

Bloomberg, J. (2018) *Digitization, Digitalization, And Digital Transformation: Confuse Them At Your Peril*, *Forbes*. Available at: https://www.forbes.com/sites/jasonbloomberg/2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/ (Accessed: 2 May 2019).

Bouza, A. (2019) *What is Digital Transformation, Digitalization, and Digitization*, *Medium*. Available at: https://medium.com/api-product-management/what-is-digital-transformation-digitalization-and-digitization-c76277ffbdd6 (Accessed: 25 August 2019).

Chandak, S., Chandak, A. and Sharma, A. (2014) 'Globalisation of Supply Chain Management for an Automotive Industry-future Perspective', p. 10.

CMP (2015) *Port of the Month: CMP – Copenhagen Malmö Port (Denmark/Sweden)*. Available at: https://www.espo.be/news/port-of-the-month-cmp-copenhagen-malmo-port-denmar (Accessed: 26 August 2019).

Coles, F. (2017) *The True Implications of the Technology Revolution*, *The Maritime Executive*. Available at: https://www.maritime-executive.com/blog/the-true-implications-of-the-technology-revolution (Accessed: 22 August 2019).

Del castillio, M. (2018) *IBM-Maersk Blockchain Platform Adds 92 Clients As Part Of Global Launch*. Available at: https://www.forbes.com/sites/michaeldelcastillo/2018/08/09/ibm-maersk-blockchain-platform-adds-92-clients-as-part-of-global-launch-1/#ac2aec968a4a (Accessed: 5 May 2019).

DNV GL (2018) *Digitalization in the maritime industry*, *DNV GL*. Available at: https://www.dnvgl.com/maritime/insights/topics/digitalization-in-the-maritime-industry/index.html (Accessed: 19 August 2019).

DP world, A. (2017) *Port of Antwerp launches big data platform NxtPort | DP World Antwerp*. Available at: http://www.dpworldantwerp.com/media/newsletters/port-of-antwerp-launches-big-data-platform-nxtport (Accessed: 24 February 2019).

Dullaert, W. *et al.* (2007) 'Supply chain (re)design: support for managerial and policy decisions?', in.

Egloff, C. and Sanders (2018) *The Digital Imperative in Container Shipping*, *https://www.bcg.com*. Available at: https://www.bcg.com/publications/2018/digital-imperative-container-shipping.aspx (Accessed: 18 February 2019).

Feibert, D. C., Hansen, M. S. and Jacobsen, P. (2017) 'An integrated process and digitalization perspective on the shipping supply chain — A literature review', in *2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*. *2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, Singapore: IEEE, pp. 1352–1356. doi: 10.1109/IEEM.2017.8290113.

Fink, A. (2008) *Practicing Research: Discovering Evidence That Matters*. SAGE.

Fruth, M. and Teuteberg, F. (2017) 'Digitization in maritime logistics—What is there and what is missing?', *Cogent Business & Management*. Edited by S. Liu, 4(1), p. 1411066. doi: 10.1080/23311975.2017.1411066.

Gandhi, R. (2019) *The Benefits of Containerization and What It Means for You*, *IBM Cloud Blog*. Available at: https://www.ibm.com/blogs/bluemix/2019/02/the-benefits-of-containerization-and-what-it-means-for-you/ (Accessed: 5 May 2019).

Goksu, M. (2017) *The History of Shipping Before Containers*, *More Than Shipping*. Available at: https://www.morethanshipping.com/history-shipping-containers/ (Accessed: 3 May 2019).

Gupta, S. (2018) 'TRITA-ITM-EX 2018 : 359 Organizational Barriers to Digital Transformation', in.

Henderson, J. (2018) *Port of Rotterdam embarks on digital transformation programme with IBM | Technology | Supply Chain Digital*. Available at: https://www.supplychaindigital.com/technology/port-rotterdam-embarks-digital-transformation-programme-ibm (Accessed: 1 August 2019).

Henriette, E., Feki, M. and Boughzala, I. (2015) 'The Shape of Digital Transformation: A Systematic Literature Review', in *MCIS*.

IBM & MAERSK (2018) *Overview - TradeLens Documentation*. Available at: https://docs.tradelens.com/learn/tradelens_overview/ (Accessed: 31 July 2019).

ICS (2017) *ICS | The Regulation of International Shipping*. Available at: http://www.ics-shipping.org/shipping-facts/safety-and-regulation/the-regulation-of-international-shipping (Accessed: 5 May 2019).

ICS, L. (2019) *ICS | Shipping and World Trade*. Available at: http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade (Accessed: 22 August 2019).

International, P. S. A. (2018) 'Blockchain in The Multimodal Transport System', *PSA International*, 3 May. Available at: https://www.globalpsa.com/blockchain-in-the-multimodal-transport-system/ (Accessed: 2 August 2019).

Jang, D. *et al.* (2002) 'Applying digital manufacturing technology to ship production and the maritime environment', *Integrated Manufacturing Systems*, 13(5), pp. 295–305. doi: 10.1108/09576060210429748.

Kenton, W. (2019) *How Supply Chains Work*, *Investopedia*. Available at: https://www.investopedia.com/terms/s/supplychain.asp (Accessed: 1 August 2019).

KInthaert, L. (2017) *Digital Transformation: How Will it Change the Seafarer's Role?* Available at: https://knect365.com/shipping/article/842b789d-aa16-411f-95c9-6393715daf35/digital-transformation-how-will-it-change-the-seafarers-role (Accessed: 25 February 2019).

Klomperee, J. (2000) 'Improvement of port operation, service efficiency and competitiveness, in order to meet the logistical needs of clients : a case study of Bangkok port container terminals', p. 119.

Kongsberg (2017) *YARA and KONGSBERG enter into partnership to build world's first autonomous and zero emissions ship - Kongsberg Maritime*. Available at: https://www.kongsberg.com/maritime/about-us/news-and-media/news-archive/2017/yara-and-kongsberg-enter-into-partnership-to-build-worlds-first-autonomous-and/ (Accessed: 25 August 2019).

Kvamstad-Lervold, B. (2017) '9 PATHS INTO THE MARITIME FUTURE', p. 24.

Lacey, M. and Lisachuk, H. (2015) *The Internet of Things in the shipping industry | Deloitte Insights*. Available at: https://www2.deloitte.com/insights/us/en/focus/internet-of-things/iot-in-shipping-industry.html (Accessed: 9 August 2019).

Lambrou, M. (2017) *(PDF) Shipping 4.0: Technology Stack and Digital Innovation Challenges*, *ResearchGate*. Available at: https://www.researchgate.net/publication/320102036_Shipping_40_Technology_Stack_and_Digital_Innovation_Challenges (Accessed: 25 February 2019).

Lavrakas, P. (2008) *Encyclopedia of Survey Research Methods*. 2455 Teller Road, Thousand Oaks California 91320 United States of America: Sage Publications, Inc. doi: 10.4135/9781412963947.

Lee, P. T.-W., Kwon, O. K. and Ruan, X. (2019) 'Sustainability Challenges in Maritime Transport and Logistics Industry and Its Way Ahead', *Sustainability*, 11(5), p. 1331. doi: 10.3390/su11051331.

Leonard, M. (2019) *CMA CGM adds 50K container trackers to its fleet*, *Supply Chain Dive*. Available at: https://www.supplychaindive.com/news/cma-cgm-adds-50k-container-trackers-traxens-IoT/555530/ (Accessed: 26 August 2019).

Levins, C. (2018) *9 Ways Blockchain Will Affect the Shipping Industry*. Available at: http://www.airseacontainers.com/blog/9-ways-blockchain-will-affect-the-shipping-industry/ (Accessed: 5 May 2019).

Littlefield, M. (2015) *Heppelmann and Porter Strike Again: Analyzing the IoT Implications*. Available at: https://blog.lnsresearch.com/heppelmann-and-porter-strike-again-analyzing-the-iot-implications (Accessed: 3 August 2019).

Madden, D. (2017) *How Technology Is Changing the World of Shipping Consumer Goods*, *Wonolo*. Available at: https://www.wonolo.com/blog/technology-changing-world-shipping-consumer-goods/ (Accessed: 21 August 2019).

Marine, I. (2019) *10 Largest Container Shipping Companies in the World*. Available at: https://www.marineinsight.com/know-more/10-largest-container-shipping-companies-in-the-world/ (Accessed: 22 August 2019).

Marr, B. (2018) *What is Industry 4.0? Here's A Super Easy Explanation For Anyone*, *Forbes*. Available at: https://www.forbes.com/sites/bernardmarr/2018/09/02/what-is-industry-4-0-heres-a-super-easy-explanation-for-anyone/ (Accessed: 3 August 2019).

McKevitt, J. (2016) *How digitization may help the shipping industry recover*, *Supply Chain Dive*. Available at: https://www.supplychaindive.com/news/shipping-digitization-rates-technology-overcapacity/432878/ (Accessed: 1 May 2019).

Medmaritimeprojects (no date) 'D.2.1.2.B_Mapping Successful Maritime Clusters'. Project Corinthos. Available at: http://www.medmaritimeprojects.eu/download/ProjectCorinthos/D.2.1.2.B_Mapping%20Successful%20Maritime%20Clusters.pdf.

Meijer, M. (2017) 'Riding the wave of digital disruption', *Inmarsat*, 22 March. Available at: https://www.inmarsat.com/riding-wave-digital-disruption/ (Accessed: 22 August 2019).

Miles, M. B. *et al.* (1994) *Qualitative Data Analysis: An Expanded Sourcebook*. SAGE.

Min, S., Zacharia, Z. G. and Smith, C. D. (2019) 'Defining Supply Chain Management: In the Past, Present, and Future', *Journal of Business Logistics*, 40(1), pp. 44–55. doi: 10.1111/jbl.12201.

Moon, S. (2017) *Keeping up with the pace of digitization: The case of the Australian construction industry - ScienceDirect*. Available at: https://www.sciencedirect.com/science/article/pii/S0160791X16301580 (Accessed: 5 May 2019).

morley, Huge. R. (2018) *Ready or not, digitalization on the way for shipping*, *IHS Markit*. Available at: https://ihsmarkit.com/research-analysis/Ready-or-not-digitalization-on-the-way-for-shipping.html (Accessed: 18 February 2019).

Nkuna, N. (2017) 'Understanding the motives for digital transformation in the container shipping sector', *World Maritime University The Maritime Commons: Digital Repository of the World Maritime University*, p. 78.

OECD (2017) 'THE ENVIRONMENTAL EFFECTS OF FREIGHT'.

Olesen, P. B. *et al.* (2014) 'Framework for Information Sharing in a Small-to-Medium Port System Supply Chain', in Bayro-Corrochano, E. and Hancock, E. (eds) *Progress in Pattern Recognition, Image Analysis, Computer Vision, and Applications*. Cham: Springer International Publishing, pp. 257–264. doi: 10.1007/978-3-662-44739-0_32.

Ortiz-Ospina, E., Beltekian, D. and Roser, M. (2018) 'Trade and Globalization', *Our World in Data*. Available at: https://ourworldindata.org/trade-and-globalization (Accessed: 22 July 2019).

Panayides, P. (2006) 'Maritime Logistics and Global Supply Chains: Towards a Research Agenda', *Maritime Economics and Logistics*, 8, pp. 3–18. doi: 10.1057/palgrave.mel.9100147.

Parviainen, P. and Tihinen, M. (2017) 'Tackling the digitalization challenge: how to benefit from digitalization in practice', *IJISPM - International Journal of Information Systems and Project Management*, (5(1)), pp. 63–77. doi: 10.12821/ijispm050104.

Patrick, K. (2018) *'World's smartest port': How IBM plans to digitize Port of Rotterdam*, *Supply Chain Dive*. Available at: https://www.supplychaindive.com/news/ibm-digitize-port-of-rotterdam/516006/ (Accessed: 1 August 2019).

Pillsbury, S. (2019) *Manufacturers are the leading adopters of 4IR — Quartz*. Available at: https://qz.com/1646096/manufacturers-adopt-4ir/ (Accessed: 25 August 2019).

Port of Rotterdam (2018) *Digital infrastructure*, *Port of Rotterdam*. Available at: https://www.portofrotterdam.com/en/doing-business/port-of-the-future/digitisation/digital-infrastructure (Accessed: 1 August 2019).

Porter, M. E. and Heppelmann, J. E. (2014) 'How Smart, Connected Products Are Transforming Competition', *Harvard Business Review*, 1 November. Available at: https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition (Accessed: 3 May 2019).

Raimond, V. K. (2015) 'Top 4 Challenges You Need to Master for International Shipping', *Talking Logistics with Adrian Gonzalez*, 10 September. Available at:

https://talkinglogistics.com/2015/09/10/top-4-challenges-you-need-to-master-for-international-shipping/ (Accessed: 26 August 2019).

Rødseth, Ø., Perera, L. and Mo, B. (2016) 'Big data in shipping - Challenges and opportunities', in.

Sanjari, M. *et al.* (2014) 'Ethical challenges of researchers in qualitative studies: the necessity to develop a specific guideline', *Journal of Medical Ethics and History of Medicine*, 7. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4263394/ (Accessed: 4 May 2019).

Saunders, M., Lewis, P. and Thornbill, A. (2000) *Research Methods for Business Studies*.

Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research Methods for Business Students*. Prentice Hall (Always learning). Available at: https://books.google.ie/books?id=u-txtfaCFiEC.

Saxon, S. and Stone, M. (2017) *How container shipping could reinvent itself for the digital age | McKinsey*. Available at: https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/how-container-shipping-could-reinvent-itself-for-the-digital-age (Accessed: 26 August 2019).

Scott, T. (2018) *TradeLens: How IBM and Maersk Are Sharing Blockchain to Build a Global Trade Platform*, *THINK Blog*. Available at: https://www.ibm.com/blogs/think/2018/11/tradelens-how-ibm-and-maersk-are-sharing-blockchain-to-build-a-global-trade-platform/ (Accessed: 2 August 2019).

Seman, A. J. (2005) 'Next Generation Navy Ship Automation Systems Engineering From Sensors to Systems', in *2005 IEEE International Conference on Systems, Man and Cybernetics*. *2005 IEEE International Conference on Systems, Man and Cybernetics*, pp. 1218–1222. doi: 10.1109/ICSMC.2005.1571312.

Shin, S. (2018) *Technical Trends Related to Intermodal Automated Freight Transport Systems (AFTS) * - ScienceDirect*. Available at: https://www.sciencedirect.com/science/article/pii/S2092521218300312 (Accessed: 25 February 2019).

ShipTechnology (2018) 'Is shipping still unprepared for cyberattacks?', *Ship Technology*, 24 September. Available at: https://www.ship-technology.com/features/shipping-still-unprepared-cyberattacks/ (Accessed: 26 August 2019).

Sun, D., Zhang, X. and Yu, M. (2006) 'Applications of Workflow in Supply Chain Management: A Case Study', in *2006 IEEE International Conference on Service Operations and Logistics, and Informatics*. *2006 IEEE International Conference on Service Operations and Logistics, and Informatics*, pp. 540–544. doi: 10.1109/SOLI.2006.328944.

Tas, Z. (2018) *Big Data in the Shipping Industry*, *More Than Shipping*. Available at: https://www.morethanshipping.com/big-data-in-the-shipping-industry/ (Accessed: 26 August 2019).

Temple, G. (2018) '3D printing & the marine industry', *SAFETY4SEA*, 25 September. Available at: https://safety4sea.com/3d-printing-the-marine-industry/ (Accessed: 26 August 2019).

Thetius (2018) 'Brief guide to artificial intelligence in shipping – Thetius'. Available at: https://thetius.com/brief-guide-to-artificial-intelligence-in-shipping/ (Accessed: 25 August 2019).

Tien, J. M. (2015) 'Internet of connected ServGoods: Considerations, consequences and concerns', *Journal of Systems Science and Systems Engineering*, 24(2), pp. 130–167. doi: 10.1007/s11518-015-5273-1.

Tihinen, M. and Teppola, S. (2017) 'Tackling the digitalization challenge: how to benefit from digitalization in practice'. doi: 10.12821/ijispm050104.

Tradelens (2019) *TradeLens | Digitizing the global supply chain and transforming trade*. Available at: https://www.tradelens.com/ (Accessed: 3 May 2019).

TransportGeography (2018) 'Digital Intermodalism: Blockchains and Intermodal Transportation', *The Geography of Transport Systems*, 15 January. Available at: https://transportgeography.org/?page_id=8517 (Accessed: 2 August 2019).

UNCTAD (2018) *Digitalization set to revolutionize shipping – new United Nations report*. Available at: https://unctad.org/en/pages/PressRelease.aspx?OriginalVersionID=472 (Accessed: 25 February 2019).

United Nations Conference on Trade and Development (2017) *Review of maritime transport 2017*.

Walsh, I. *et al.* (2015) 'What Grounded Theory Is…A Critically Reflective Conversation Among Scholars', *Organizational Research Methods*, 18(4), pp. 581–599. doi: 10.1177/1094428114565028.

Wingrove, M. (2018) *10 technologies to shake up maritime in 2018*. Available at: https://www.marinemec.com/news/view,ten-technologies-to-shake-up-maritime-in-2018_50317.htm (Accessed: 24 February 2019).

Woo, S.-H., Pettit, S. and K C Beresford, A. (2011) 'Port evolution and performance in changing logistics environments', *Maritime Economics and Logistics*, 13, pp. 250–277. doi: 10.1057/mel.2011.12.

## 7.1 Appendix A

**Appendix A**: Transcript from interview

**Participant details**: *Sim, Global chief Digital & information officer in MSC (Mediterranean Shipping Corporation).*

Q1. How do you perceive shipping evolvement from a traditional and conservative sector to an adoption of new technologies? How fast companies are adopting new technologies?

We are living in an increasingly digital and on-demand world, and the customers are pushing the industry to modernize processes and offer a higher digital support. Hence, evolving towards digitalization is not a matter of choice anymore *and shipping companies have realized that they are lagging in terms of technology comparing to other sectors. Nevertheless, some steps have been taken towards digitalization* and industry standardization leading to increased interoperability. There is still a long way to go and the key to achieve faster results is the cooperation among the participants contributing to set higher level of standardized processes.

Q2. What is the nature of technologies that are available in market under process? Where you see the future of shipping?

Technologies as cloud computing and Blockchain have the ability to help transformation within maritime sector. Nowadays, many parties (terminals, carriers, customs, etc.) exchange information through various channels, which leads to delays, misunderstandings and other complications. Thanks to Blockchain technology parties involved in shipping will be able to share information through a secure, transparent and trusted way, which has the potential to enhance the information accuracy and to reduce the processing time. Other technologies like IoT, enable the tracking of goods and offers to the customer real-time visibility sensitive shipping information, such as cargo location, temperature and handling processes, that empower carriers to increase the trust relation with the end customer. However, the smooth application and implementation of these technologies across the industry can only be possible through standardization and collaboration, and there is where the future lies.

3. What are the challenges and restraints that companies could be facing while transforming their processes? Factors like govt. policies, regulations, resources, safety?

We need digital standards to enable full implementation of the technologies along the industry. As we evolved, interlocking parts began using different communication formats and protocols and the system became very complex. Recently major carriers have created a new container line association (DCSA) aiming at collaborating on industry digital standards. The purpose is to pave the way for interoperability through digitalization and standardization and create sstandard ways to talk to each other, implementing online exchange of information under a globally agreed-upon standards from everything like location codes to regulatory definitions.

Q4. What is the extent of changes observed on shipping processes with adoption of these technologies?

New accessible platforms have been designed for all shipping and logistics providers. For instance, recently we have joined a digital shipping platform using blockchain technology called Tradelens, which will enable the exchange information and visibility between customers, carriers and all the main participants of the sector. Another example is the smart container that illustrates the big change going on in our industry. A standard container fitted with a Traxens device, which monitors position, movement, temperatures, shocks and reports back information.
From a future perspective, the processes will be more efficient and streamlined and complexities in the logistics supply chain will be reduced.

Q5. How this innovation and transformation will impact on supply chain and logistics industry?

Today, one of the main difficulties on the supply chain is the lack of visibility for the stakeholders on the overall process, that added to the harmonized way of exchanging information within different actor are, commonly, causing ruptures and unwanted costs, this is what these technological innovations are aiming to solve. By having more transparency throughout the entire chain, companies will have a more accurate data to smartly operate business and better plan investments, that benefits clients, carriers and last-mile operators.

Q6. How will it affects on different elements of supply chain like warehousing, tracking & transportation?

All the parties will have the chance to adapt to the new technologies in order to accomplish with the standards settled. All the actors involved are going to benefit of a more transparent and assertive data sharing throughout the supply chain, by doing that, the consequences will be costs reduction and new business opportunities.

Q7. What is the extent of improved digital infrastructure on ports? What are the differences that have been observed in different ports with respect to advanced infrastructure, time of processing?

Terminal operators can benefit of the data visibility and harmonized way of exchanging information to correctly plan their operations minimizing bottlenecks on the process, transportation companies can estimate accurately when to pick-up/drop-off a container, reducing or even extinguishing traffic around port regions, customs have their processes already improved by using block chain based solutions, that shows that not only the companies are going to improve their processes but the entire shipment ecosystem.

Q8. Will these technologies be able to transform whole shipping industry, or will it be limited to few giants which are having resources to develop and implement these technologies?

The whole shipping industry will benefit from this revolution, either directly or indirectly. We are seeing a huge movement today of start-ups which can provide good quality solutions on the

interoperability of supply chain for affordable prices, also, the increasing amount of companies providing services on the digital innovation tends to push the prices down and the quality up, likewise, not only the big ones will be profiting from the solutions.

Q9. What are the new market opportunities that will develop with the introduction and adaption of technologies? Opening of new markets and service providers?

Technologies could bring several opportunities, especially in terms of process optimization. Automated services will enhance the speed and quality of operations, to offer a better end to end service for the customer. Integrated services can increase customer satisfaction and by that mean create customer loyalty. In terms of new market opportunities, technology will enable even safer shipping than today. Smart containers monitoring the quality of the good and transmitting live information to the customer creating more transparency to some specific industries such as pharma and other markets related to food safety.
Companies that now have more visibility can foresee how to act on the market and may propose to their clients, services based on data collected and analysed.

Q10. Where do you see the involvement of government govern bodies and international organizations like IMO to boost upon and invest in such ventures?

Regulatory bodies and international institutions are getting more and more involved on the usage of innovative solutions, a good example of that are the customs from many countries, that now can receive, process and validate trading documents via digital ways, by adhering to the innovation and interoperable platforms. On top of that, international groups can act on facilitating the implementation and regulation of all the available tools into a harmonized and secured process.

Q11. As shipping is very vulnerable to fluctuations in economies and geopolitical factors, how these technological advancements will impact on such scenarios?

By consuming and processing data, including historic data on past shipments, as well as by analysing macro-economic parameters such as the global demand of products by categories. It would be possible to build Supply & Demand models which will enable shipping companies to perform predictive analysis, which will help us in forecasting those fluctuations and consequently make decisions to absorb those changes proactively

## 7.2 Appendix B

# Griffith College Ethics Committee Guiding Principles

## Part 1

Researchers in Griffith College are committed to adhering to the highest ethical standards. These ethical standards include the principles of informed consent, the right to withdraw from research, data protection, and respect for human rights and equality as well as sensitivity to issues arising from inequalities of power. It also recognizes that there are particular ethical issues in research involving children, young people and vulnerable adults and that such research involves particular attention. Vulnerable populations may include, for example, children, people with a learning disability, prisoners, and those in a subordinate position to the researchers.

The purpose of Griffith College's Ethics Committee (GCEC) is to review research projects before they commence in order to assess their ethical implications and to provide guidance, support and approval to researchers on ethical issues.

Our obligation to research participants includes an obligation to explain, in accessible terms, what the research is about, who is undertaking it, funding it (if applicable) and why it is being undertaken. The creation of a Research Ethics Approval Form (see part 1 below) requires postgraduate learners (in conjunction with their supervisor) and staff engaged in research involving humans to consider the ethical implications of their research proposal and to create and include an information sheet as part of their application for ethics approval.

Consent is a fundamental research principle and this Research Ethics policy proposes that it should be documented and explicit. All consent forms should be clear and easy to understand and should explain to participants what is involved in the research (including any identifiable risks). Participants should be made aware in a consent form that participation is voluntary, that they can withdraw at any time and without subsequent effect to them. It is important that no pressure should be exerted on participants and/ or that no unreasonable inducement be offered in order to gain consent. Participants should either be assured of confidentiality or advised on the limits of confidentiality i.e. participants should be aware that confidentiality of information provided can only be protected within the limitations of the law (depending on the nature of the research proposal, these limitations may need to be stated). In the case of unobtrusive observational or covert research, care should be taken to ensure that the research is justified and that the benefit of undertaking the research outweighs the risk (such as invasion of privacy).

It is important also to recognize that all researchers must be appropriately qualified and have sufficient experience to lead or conduct the research. In the case of student researchers, faculties must ensure that adequate training has been given.

**LEARNER GUIDELINES ON RESEARCH ETHICS**

## Part 2

1. The purpose of the ethical review process is to offer advice, support and guidance on ethically appropriate research and as such the process should be viewed as a support to good research practice.
2. All postgraduate research projects proposing to do academic research involving humans are required to seek ethical approval from Griffith College's Ethics Committee.
3. The process of gaining ethical approval begins by first completing Griffith College's Ethics Approval Form which is contained in part 2 of this document. The form itself and its implications for your research should be considered by you and then discussed with your supervisor.
4. It is important that you consult widely with your supervisor before you submit the Ethics Approval Form.
5. The completed application should be proofread and spellchecked before submission by you to the GCEC. It should also be signed by your supervisor before submission.
6. No data collection should be carried out on your project until you have received written approval from the GCEC.
7. The application form must be completed in full, and submitted due date. Late submissions will result in a delay in applications being processed.
8. Applicants should provide submit a signed and scanned copies of the form via Moodle, in the Dissertation course.
9. Incomplete Research Ethics Approval Forms will not be accepted and will be returned. This will result in a delay in processing your application.
10. Griffith College Ethics Committee convenes approximately 4 times a year or more frequently if the need arises. The Committee is comprised of the Head of Teaching and Learning, the Head of the Research Committee, Head of Library Services, and Research Supervisor.
11. The GCEC will endeavour to process applications as quickly as possible. Please note that if a project is judged to be of particular risk, the GCEC may forward your proposal to the College EC for advice and guidance.
12. The GCEC is not concerned with methodological issues but may choose to comment on them in so far as they have ethical implications.
13. If your application is successful, your Supervisor will receive written notification and you can commence data collection and proceed with your project.
14. If your application receives comment and suggestions for ethical improvement, I is important that you incorporate these into your research process.

15. Any departure from the approved submission or the submission that receives recommendations must be discussed with the Research Supervisor and may require additional ethical approval.
16. The Research Supervisor will receive written notification of approval/ recommendations and you can then commence data collection and proceed with your project.
17. If your application is unsuccessful, your Research Supervisor will receive written feedback explaining the decision and advising on the next course of action. You will be invited to reconsider your application in light of this feedback.

## Part 3: Griffith College Ethical Approval Form

This form should be completed by the researcher (with the advice of the Research Supervisor), for all research which involves human participants.

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| **Research Title** | A qualitative exploration and Assessment of Project Management In Pharmaceutical Drugs' Research and Development Process |
| **Researcher(s)/Student** | Kanwalpreet Singh |
| **Supervisor (where relevant)** | Dhafer Alahmari |
| **Programme of Study (where relevant)** | MSc. International Procurement and supply chain management. |

**Checklist:**

| | |
|---|---|
| *Please attach to all forms:* | |
| Summary of Project Proposal (no more than 500 words) | |
| Participant Information Sheet | |
| *If applicable, application should also include the following:* | |
| Draft Consent Form | |
| Draft Research Instrument e.g. survey, interview schedule, focus group questions etc | |

Part (a)

| | | Yes | No | N/A |
|---|---|---|---|---|
| 1 | Will you describe the main research procedures to participants? | ✓ | | |
| 2 | Will you tell participants that their participation is voluntary? | ✓ | | |
| 3 | Will you obtain written consent for participation? | ✓ | | |
| 4 | If the research is observational, will you ask participants for their consent to being observed? | ✓ | | |
| 5 | Is the right to freely withdraw from the research at any time made explicit to participants? | ✓ | | |

| | | | | |
|---|---|---|---|---|
| 6 | Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs? | ✓ | | |
| 7 | Will you debrief participants at the end of their participation? | ✓ | | |
| 8 | Will your research involve discussion of topics which the participants might find sensitive? | | ✓ | |
| 9 | Will financial inducements (other than reasonable expenses or compensation for time) be offered to participants? | | | ✓ |
| 10 | Will your project involve deliberately misleading participants in any way? | | ✓ | |
| 11 | Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort? | | ✓ | |
| 12 | Does your research involve participants who are particularly vulnerable or who may feel unable to give informed consent e.g. Prisoners; children; people for whom English is not their first language; learners in a programme you teach on? | | ✓ | |
| 13 | Will any non-anonymised and/personalised data be generated and/stored? | | ✓ | |

**If you answered YES to any of questions 8 to 13 please complete Part (b) of this form. If there are any other ethical issues that you think the Committee should consider, please explain them in Part Two of this form. It is the researcher's obligation to bring to the attention of the Committee any ethical issues not covered on this form.**

Part (b)

For each question 8 to 13 that you answered YES, please give a summary of the issue and action to be taken to address it (no more than 300 words in total):

N/A

**Signed (by Researcher):** Kanwalpreet Singh
**Date:** 12-072019

To be completed by the Research Supervisor (in the case of a student application)

PLEASE TICK ONE

As the Research Supervisor of this research project, I confirm that I believe that all ethical issues relating to research have been dealt with in accordance with the College's policy on research ethics. ✓

The application requires the attention and approval of Griffith College Ethics Committee. (In general, forms which answer 'yes' to questions 8-13, should be forwarded to Griffith College Ethics Committee). ☐

Comments:

**Signed (Supervisor):**
**D**hafer Al ahmari

**Date: 25/07/2019**

## Summary of Project Proposal

Shipping is an integral part of supply chain and major proportion of cargo movement globally is carried out through ships. Shipping represents 90% of world trade and considered as a life blood of global economy. As per UNCTAD in 2016 10287 million tons of cargo was carried by shipping and around 20 million containers have moved throughout the world covering 55057 billion ton-miles of distance all around the world (United Nations Conference on Trade and Development, 2017). Other than being economical, ocean freight is much more environmental friendly then other modes of transport with an extensive coverage throughout the world and multiple carrier options available for customers (OECD, 2017).

But since its inception and revolution in containerization shipping has always been a conservative sector in adoption of new technologies and to innovate further as it revolves around compliance with loads of laws and legislation in terms of environment, health & safety and safe

practices(Morley, 2018). Moreover due to involvement of long paper trail regarding customs, bills of cargo, port clearance, safety documents it slows down the process and ultimately affecting the whole efficiency of supply chain. The strong focus is to be put on the theories, technologies and tools used for an effective understanding of extent of digitalization on shipping and logistic sector and their overall effect on whole supply chain and logistics industry and to be able enough to analyze the factors that improve the process

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